Ref. Ares(2023)8834294 - 22/12/2023

Urban Planning and design ready for 2030

D2.3 - UP2030 benchmarking report against state-of-the-art and identification of pilot opportunities 2

WP2– UP Dating

Co-funded by the European Union

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This project has received funding from the Horizon Innovation Actions under the grant agreement n° 101096405.

Document Information

Grant Agreement Number	101096405	Acronym	UP2030		
Full Title	**Urban Planning and design ready for 2030**				
Start Date	01/01/2023	**Duration**		36 months	
Project Website	**https://up2030-he.eu/**				
Deliverable	**D2.3– UP2030 benchmarking report against state-of-the-art and identification of pilot opportunities 2**				
Work Package	**WP2 UP-DATING Understanding cities and stakeholders' needs for upgrading, and co-designing visions of urban transformations**				
Date of Delivery	**Contractual**	30/12/2023	**Actual**	22/12/2023	
Nature	**R-Report**	**Dissemination Level**		**PU-Public**	
Lead Beneficiary	**UIC**				
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Abstract	This deliverable proposes a qualitative benchmarking system for orientating cities' goals and guide climate implementation strategies. Its aim is to align urban policies, projects, and design with the innovative carbon neutrality approach of UP2030: the concept of "just and resilient carbon neutral city". This integrated perspective guides the benchmarking systems for questioning city goals and implementation roadmap, trying to drive cities toward carbon neutral pathways which are not gentrifying (but aligning with climate justice), nor inducing trade-offs with climate change adaptation measures. The imperative of avoiding green gentrifications, green washing while supporting a carbon neutrality transition is the pillar of this benchmarking system. The deliverable starts by introducing a state-of-the-art about existing frameworks and benchmarking, followed by a literature review to identify the current cities' urban transformation barriers across Europe, to better understand why and where (which governance dimension) to focus in order to unlock the potential for sustainable change. In a second part the UP2030 benchmarking system is explained. It consists of a three-step system, each having a different focus: i) elaborated through city models it aims at inspiring cities in the definition of their goals, ii) the second one introduces an "action filter", whose goal is to ensure that climate actions				

	consider all the aspects of the UP2030 approach, and iii) the third step develops a set of KPIs depending on cities' climate action implementation pathway, to measure its progress

Document History

Version	Issue Date	Stage	Description	Contributor
0.1	30/06/2023	Final draft	Submission of the final draft D2.1	UIC
0.2	17/11/2023	ToC Draft	Design of table of contents	UIC
0.2.1	22/11/2023	Review ToC	Review of table of content, executive summary, and alignment	Fraunhofer
0.3	29/11/2023	1st Draft	1st draft of the deliverable	UIC
0.4	5/12/2023	Review	Review 1st draft	Fraunhofer
0.5	11/12/2023	2nd Draft	2nd draft of the deliverable	UIC
0.6	15/12/2023	2nd Review	Review of the 2nd draft	RCities
1.0	20/12/2023	Final deliverable	Final version ready for submission	UIC

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Executive summary

Urban assessment systems have become a useful tool for local administrations to evaluate and monitor the impact and performances of implemented measures and actions. Within UP2030, the WP2 "UP-Dating: understanding cities and stakeholders' needs for upgrading, and co-designing visions of urban transformations" aimed to deliver a step-by-step self-assessment to guide cities in defining their visions for carbon neutrality but also supporting the definition of how to reach those targets through climate actions able to integrated carbon-neutral, resilience and justice along the urban transformation.

The conceptual pillar guiding the benchmarking is the UP2030 approach of "just and resilient carbon neutral city". This integrated perspective orientates cities toward carbon neutral pathways which are not gentrifying (but aligning with climate justice), nor inducing trade-offs with climate change adaptation measures. The imperative of avoiding green gentrifications and green washing while supporting a carbon neutrality transition is the milestone of this self-assessment and it is present across different section of this benchmarking. Indeed, in order to provide practical guidance, the benchmarking has been split in three different parts, addressing different phases of a city planning cycle. Indeed, it is not the same to provide a self-assessment to a city which is defining its goals, than a city having a climate plan to implement and looking for measuring its climate resilience performance. To respond to those different needs, the benchmarking system has been divided in three different parts, which can be used individually, or step by step along a climate planning journey, from climate goals, to planning to implementation.

The document is structured into four main parts. The first part introduces the UP2030 project, objective, and structure of the benchmarking, as well as its conceptual framing of driving toward "just and resilient carbon neutral cities". The second and third parts are respectively providing a state-of-the-art analysing current assessments frameworks and benchmarking systems and exploring the scientific literature on the "governance gaps in urban transformation" across Europe, to understand which are the critical dimensions and areas where most of the efforts are needed to unlock a carbon neutral transition. Finally, in the fourth part the UP2030 benchmarking system is presented in its three parts: i) the first presents different cities models and associated characteristics to inspire cities in defining their ambitions and goals, ii) the second part presents a composite "UP2030 Climate Action Filter" benchmarking cities climate actions against the need of aligning climate mitigation and adaption, addressing all the gaps for urban transformations and finally guarantee to embed spatial justice within climate actions, iii) and finally the last part which is made of Key Project Indicators (KPIs) measuring the climate projects' implementation (which is being developed in WP4 by another partner).

The document intends to serve as a multi-level benchmarking system with all the needed guidelines about how it could be used in any size of city, during different planning stages. This work is complemented by other deliverables explaining the methods for co-defining cities climate visions and adaptation pathways (D2.5) and defining KPIs for tracking just and resilient carbon neutral progresses (D4.4).

Content alignment with other UP2030 deliverables

The UP2030 project fosters exchange and cooperation among partners and deliverables beyond the WPs structure. Therefore, the content of this document has been developed in alignment with the WP leaders Fraunhofer (WP1), TUD (WP3), RCities (WP4), and the WP2 tasks leading the cities UP2030 methods (specifically through the T2.3 on barriers and needs identification, lead MfC, and T2.4 on co-designing cities' visions and adaptive pathways, led by TSPA).

The following table lists the deliverables and milestones that were input for this present document and the upcoming ones that could benefit from the content here presented.

Input from	Contributes to
D2.1 The 5UP approach and its contextualisation in the project cities.	**D2.5** Report on vision co-design methodology report and its application for pilot shared visions
D2.2 UP2030 benchmarking report against state-of-the-art and identification of pilot opportunities 1	**D4.4** Report on monitoring, evaluation and KPI validation in the 5UP-approach implementation pilots 1
D3.8 Tools and approaches for promoting inclusive participation and spatial justice 1	**D3.8** Tools and approaches for promoting inclusive participation and spatial justice 1
D4.2 UP2030 implementation plan for the pilot cities 2	**D4.7** Report on strategic learning in city twining programmes.
MS01 Start of UP2030 – Kick-off meeting conclusions.	**MS06** Cities run second workshop on vision
MS04 Cities have set-up LAAs	
MS05 Cities run first workshop on needs	

The target groups of this document, within the UP2030 consortium, are the Liaison partners, City partners, and Technical Partners. The main beneficiaries of this deliverable will be Liaison partners and task leaders working on assessments and evaluations of proposals and pilot cases. WP leaders also can be beneficiaries by formulating the linkage between their activities and the benchmarking system. City partners and Liaison partners can use the benchmarking approach for launching activities to identify needs and barriers at this stage.

Acronyms

Acronym	Full name
AI	Artificial Intelligence
AFLOU	Agriculture, Forestry and Other Land Use
BREEAM	Building Research Establishment Environmental Assessment Method
CCS	Carbon Capture and Storage
CO_2	Carbon dioxide
CoM	Covenant of Mayors
COP	Conference of the Party
D	Deliverable
EC	European Commission
EEA	European Environmental Agency
EU	European Union
EV	Electric Vehicle
GHG	Greenhouse Gas
GPC	Global Protocol for Community-Scale Greenhouse Gas Inventories
IEC	International Electronical Commission
IEEE	Institute for Electrical and Electronical Engineers
IPCC	The Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
KPI	Key Performance Indicator
LEED	Leadership in Energy and Environmental Design
LTS	Long-term Climate Strategy
M	Milestone

MACC	Marginal Abatement Cost Curves
MfC	Mapping for Change
MUFPP	Milan Urban Food Policy Pact
N	Number
NEB	New European Bauhaus
NUA	New Urban Agenda
OECD	Organisation for Economic Cooperation and Development
PED	Positive Energy District
PGIS	Participatory GIS
PV	Photovoltaic
RCities	Resilience Cities Network
SCATTER	Setting City Area Targets & Trajectories for Emissions Reduction
SDG	Sustainable Development Goals
SECAP	Sustainable Energy and Climate Action Plans
SETS	Socio-ecological-technical systems
SUMP	Sustainable Urban Mobility Plans
TUD	Delft University of Technology
UIC	Universitat Internacional de Catalunya
UPV	Universitat Politecnica de Valencia
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
WHO	World Health Organization
WP	Work package
WSUD	Water Sensitive Urban Design

1 Introduction

According to the United Nations (UN), climate change is disrupting ecosystems in an accelerated way, increasing vulnerability to all living beings on our planet. Greenhouse gas (GHG) emissions originating from human activities are unequivocally the main cause of global warming. The consumption and production patterns become a key contribution to tackle climate change. Rapid and far-reaching transitions across all sectors and systems are necessary to achieve deep and sustained emissions reductions and secure a liveable and sustainable future for all (IPCC, 2023[1]). These system transitions required an integrated approach for mitigation and adaptation actions (UNDP, 2022). Urban planning and design are essential for systems regeneration, and cities can become a key driver of change, responsible for the impacts but also for shaping the solutions for sustainability transformations (UN Habitat, 2021). Nevertheless, the challenges to conceive transformative actions, through plans and policies, or to implement those policies are huge. In that sense, through the Green New Deal, Europe committed to achieve carbon neutrality by 2050 and to cut 55% of the CO_2 emissions by 2030. This will only be possible through effective governance and effective engagement of civil society, businesses, and local, regional, and national authorities.

This first chapter aims to introduce the UP2030 project and its conceptual approach, framed around three pillars: carbon-neutrality, resilience, and spatial justice.

1.1 About UP2030: objectives and scope of the project

The UP2030 project is funded by the European Commission (EU) under the research and innovation Horizon Europe Programme from 01.2023 to 12.2026. It counts with a consortium of 47 organisations from different European countries. The main objective of the project is to guide cities through the socio-technical transitions required to meet their climate neutrality ambitions. To this end, the project sets a vision-driven strategy-based approach using urban planning and design as a vehicle to create better connected, more compact, net-zero neighbourhoods in 10 city pilots and one observer city.

The project develops the 5UP methodological framework that supports cities:

[1] https://www.ipcc.ch/report/ar6/syr/

Figure 1: UP2030 methodological framework

- **UP-dating**, those policies, codes, regulations that need to be left behind to make room for the new vision;
- **UP-skilling,** through building the capacities of the entire city stakeholder ecosystem that shall deliver actions;
- **UP-grading,** through the development of solution prototypes (digital and physical) at selected neighbourhoods;
- **UP-scaling,** to achieve city-wide impact by shaping the enabling governance arrangements and matching project portfolios to financial resources;
- **UP-taking,** by engaging with the Mission and sharing best practices across European cities.

The UP-dating process includes the definition of a benchmarking system for urban planning and design that allows cities to define their carbon-neutral targets mainstreaming adaptation and inclusiveness in their implementation strategies.

1.2 Benchmarking for 2030: Objectives and conceptual approach

Benchmarking has been used by businesses in their operations to measure themselves against internal or external standards. This process can be used to measure both internal progress and the performance against competitors, guiding internal organization, workflows but also redefining targets. Moving from business to cities, it is paramount to design and understand which are the driving pillars of a benchmarking system, asking what is measured and why. These questions bring us back to the root meaning of this project, which is to support cities toward a spatially just and resilient carbon-neutral transformation, through an integrated socio-ecological-technical system (SETS) perspective (Krueger et al., 2022).

To achieve that, **the objective of the UP2030 benchmarking framework** is to provide orientation and practical inspiration to cities and drive their goals and implementations to avoid greenwashing, or resilience-induced gentrification, and align spatial justice, resilience, and carbon neutrality within their plans and practices.

As it will be soon introduced in the next sections, the structure of the benchmarking system tackles through its different parts different phases of the urban planning cycle (goal setting, policies and planning framing and implementation). But before navigating it, herewith the deliverable dives into the conceptual review of carbon neutrality, resilience, and spatial justice, to frame their integration, and introduce our integrated UP2030 approach, driving the benchmarking framework.

Carbon-neutral City (decarbonization)

Decarbonization is a complex systemic transition that cities should address holistically through all the dimensions of this ambitious objective, thus considering transforming and aiming at:

- *Carbon-neutral urban planning:* All the efforts to tackle emissions and encourage a sustainable use of resources (energy, water, and materials). Increasing renewable energy production and consumption; proper insulation of the built environment, compact urban fabric, proximity to services, and the walkable city. Urban planning aspects should be linked to Sustainable Energy and Climate Action Plans (SECAP), Sustainable Urban Mobility Plans (SUMP), and Climate action plans.
- *Carbon-neutral design*: Cutting emissions at design stages is mainly focused on the application of technologies and innovative solutions applied to reduce CO_2 emissions and improve efficiency in consumption and production systems. It applies to green building codes, circular economy, or industrial symbiosis processes.
- *Carbon-neutral management*: Cutting emissions at urban management means establishing the mechanisms to follow and visualise the evolution of the decarbonisation process.
- *Carbon-neutral policies*: Transposition of National Energy and Climate Plans to a local level, the definition of emissions reductions for all sectors, and action plans alignment.

- *Carbon-neutral engagement & capacity building*: Engage key stakeholders to have a proper understanding of Carbon neutral meaning and strategies to cut emissions around mobility and transport systems, energy production, materials, and resources management.

Resilient City

The concept of resilience was associated with risk management in the past. Recently the climate change adaptation agenda added a variety of climate-induced systemic stresses to the business-as-usual perspective of resilience (natural hazard driven). This trend contributed to expand the metaphorical meaning of resilience, which started to be related to many "adaptive capacities": to react, respond, adapt, or transform in the face of stresses or shocks (Meerow et al., 2016). Related to cities, urban resilience was contested by many planners and political scientists, claiming its fuzziness, and contesting its usefulness, because of its multiple overlaps with sustainability, climate mitigation, and justice (Chelleri & Olazabal, 2012; Davoudi et al., 2022). Furthermore, the many trade-offs induced by local adaptive measures highlighted how resilience needs to be linked to overarching goals such as equity or sustainability, to avoid safety-gentrification as in New Olean or Medellin or other numerous case studies which demonstrated how resilience "per se" could be not desirable (Anguelovski et al., 2016; Chelleri et al., 2015; Meerow & Newell, 2016). These local specific adaptations and their multiple potential trade-offs need to be critically explored and assessed, and a benchmarking system with respect to resilience principles should guide resilience implementation in all those domains:

- *Resilient urban planning*: Capacity to conceive an urban system (beyond cities' administrative boundaries) to create the capacities and infrastructures that can coexist with current and unexpected socio-ecological-technical system threats. Integrating emergency response plans and policies with long-term urban planning, aiming at transforming the city toward a risks mitigation future, enabling people, businesses, and the built environment to adapt and coexist with the worst-case scenarios.
- *Resilient design*: understand city-built environment vulnerabilities and "urban form" resilience, and design accordingly to integrate risks' mitigation from climate, environmental, technological, health, and economic stresses. Invest in the research and implementation of innovative design and materials, prioritising the net zero and local circularity within the construction sector. The benchmarking assessment should express the accomplishment of a regenerative process of transformation of the system.
- *Resilient governance (management and policies)*: resilient governance is not just adaptive policies but embeds the restructuring of the governance process, starting from transforming current institutions' organizational structures, behaviours, and practices. This should be driven by organizational resilience principles and each city should choose and invest in the specific resilience mainstreaming governance mechanism (centralized, dedicated, integrative, distributed mainstream process).
- *Communities' Resilience*: communities' capacities to deal with transformational change should be promoted and supported from the governance process, enabling with economic, educational, and technical resources citizens and local stakeholders to be an active part of the co-design and co-management of urban infrastructures, resources, and activities.

Spatial Justice

The spatial disposition of cities already reflects existing inequalities within the social organization. On top of that, climate change policies can lead to increase inequalities, exclusion, or gentrification and therefore alter sustainability (Rocco, 2022). Hence, in order to act against inequalities, spatial justice should be embedded within carbon neutrality and resilience thinking. Planning for spatial justice includes taking into account the following domains of actions:

Reducing the socio-economic vulnerability for urban transformation means:

- *Spatial justice in urban planning*: Socioeconomic impact of decarbonisation or resilience actions. How people are facing the change (transition) in a sustainably, without compromising their dignity, equality, and livelihood. In terms of urban planning, actions should be focused on gentrification process awareness, security, and employment rates by productive sectors.
- *Spatial justice in design*: Indicators that allow to measure the impact of design on the just transition. Here, the side effects of design could be related to security in public space, gender perspective on mobility and use of public spaces, or architectural barriers to vulnerable groups: children, elderlies, immigrants, women.
- *Spatial justice in management*: Mechanisms to follow up the evolution and behaviour of socioeconomic variables to alert about potential risks on the just transition accomplishment.
- *Spatial justice in policies:* Regulatory framework to protect people's livelihood and integrity, paying attention to vulnerable groups with risk of poverty and social exclusion due to urban planning.
- *Spatial justice in engagement and capacity building*: Encourage a proper understanding of social consequences of urban planning and design decisions to stakeholders involved.

An integrated "Just and Resilient Carbon Neutral city" approach

Cities worldwide are actively aiming to become "greener" by adopting policies and initiatives aimed at enhancing green infrastructure, increasing renewable energy usage, and creating car-free public spaces, and so on. Awards have been given to many municipalities to congratulate their resilience models (even though often based solely on critical infrastructures) or their drought and heatwave plans. Similarly, many districts and communities have been recognized internationally as best practices for grassroots initiative.

While there is abundant information online and in scientific literature regarding best practices, frameworks, and measurement systems for urban sustainability, the focus on carbon-neutral policies may fall short in optimizing resilience and ensuring spatial justice by balancing winners and losers.

After briefly explaining the meaning of the three project domains (climate-neutrality, resilience, spatial justice), this deliverable calls here for their integration within a conceptual framework, introducing the concept of a "just and resilient carbon-neutral city pathway". This integration is represented by the image below.

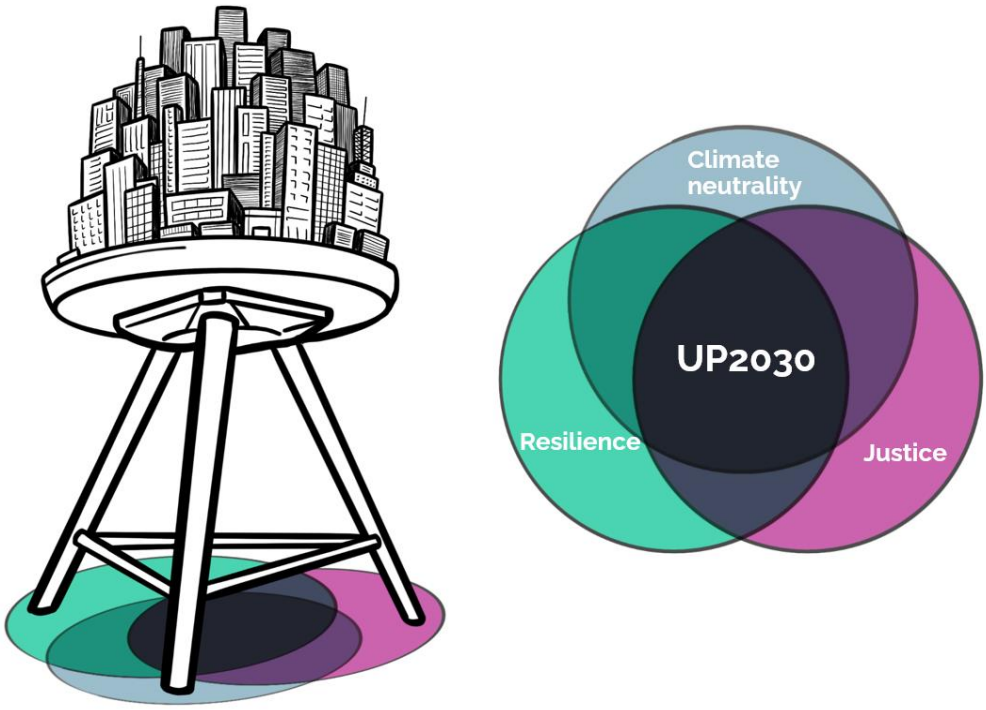

Figure 2: Integration of the three UP2030 pillars

As one can imagine looking at this stool, our city can stand robustly in equilibrium on its legs only if spatial justice and risk reduction actions are supporting a development path rooted in sustainability and carbon neutrality. Each leg of this metaphorical stool holds equal significance, emphasizing the need for a holistic approach in city planning: mitigating inequalities, promoting sustainability, shielding against potential risks.

The UP2030 benchmarking framework aligns with this stood concept, and addresses the following two main objectives:

- Establish **a clear conceptual framework** about **which principles and targets define a "Resilient and Just Carbon Neutral city"**.
- Integrate and frame these targets according to the cities' sustainable transformations **implementation gaps** focused on organisational bottlenecks.

To reach these objectives, existing cities' frameworks have been reviewed, UP2030 technical partners prepared a state-of-the-art about their field of expertise, indicators for the cities to aim for have been benchmarked (cities models), and finally the governance (institutional) gaps that European cities are facing in implementing the carbon neutrality, justice and resilience pathways have been identified. The result is a benchmarking framework that has been designed around the institutional barriers preventing action, to unlock cities' potential to move ahead following the principles and indicators of integrated just-resilient carbon neutral city.

1.3 UP2030 Benchmarking structure

Rather than a generic benchmarking approach, focus about what cities should benchmark (policies, projects, indicators on the built environment), a three-step benchmarking system has been developed. Each of these "step" is a stand-alone benchmarking that refers to different stages of a city planning cycle, elaborated by the Delft University of Technology and presented in the graphic below:

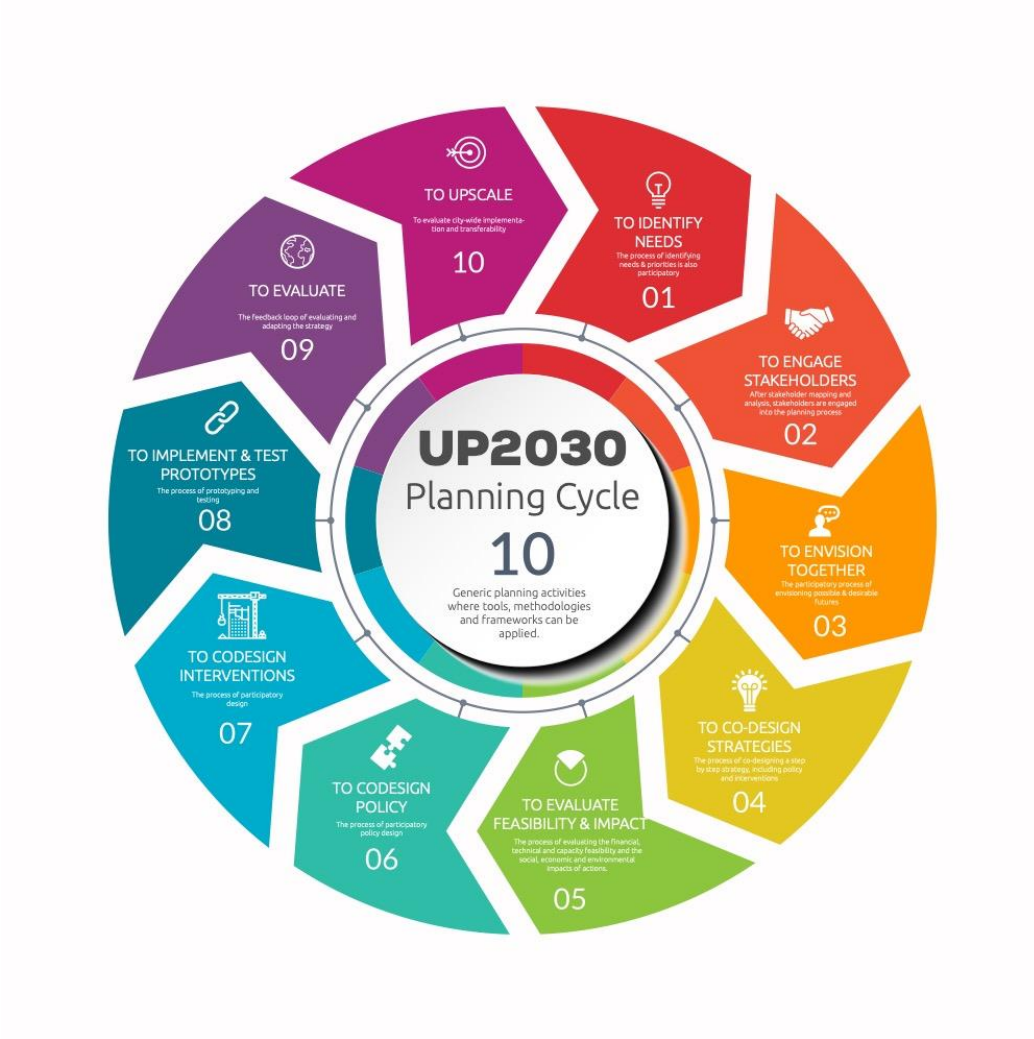

Figure 3: The UP2030 Planning cycle. Source: UP2030 project framework

The aim is to accommodate the requirements of each city and align with the UP2030 project timeline.

This step-by-step structure addresses different objectives:

- Ensuring that the benchmarking process is aligned with the methodology of the UP2030 project (the 5Ups introduced at the beginning of the deliverable: Update, Upgrade, etc.)

- Providing distinct steps with different levels of detail to adapt the benchmarking to different plans, policies, or projects to be assessed.
- Ensuring that the method of the benchmarking is transferable and replicable, allowing other cities beyond the project's pilots to implement the benchmarking process effectively.

To put it graphically and get into the structure details, the image below shows the three steps of the benchmarking system.

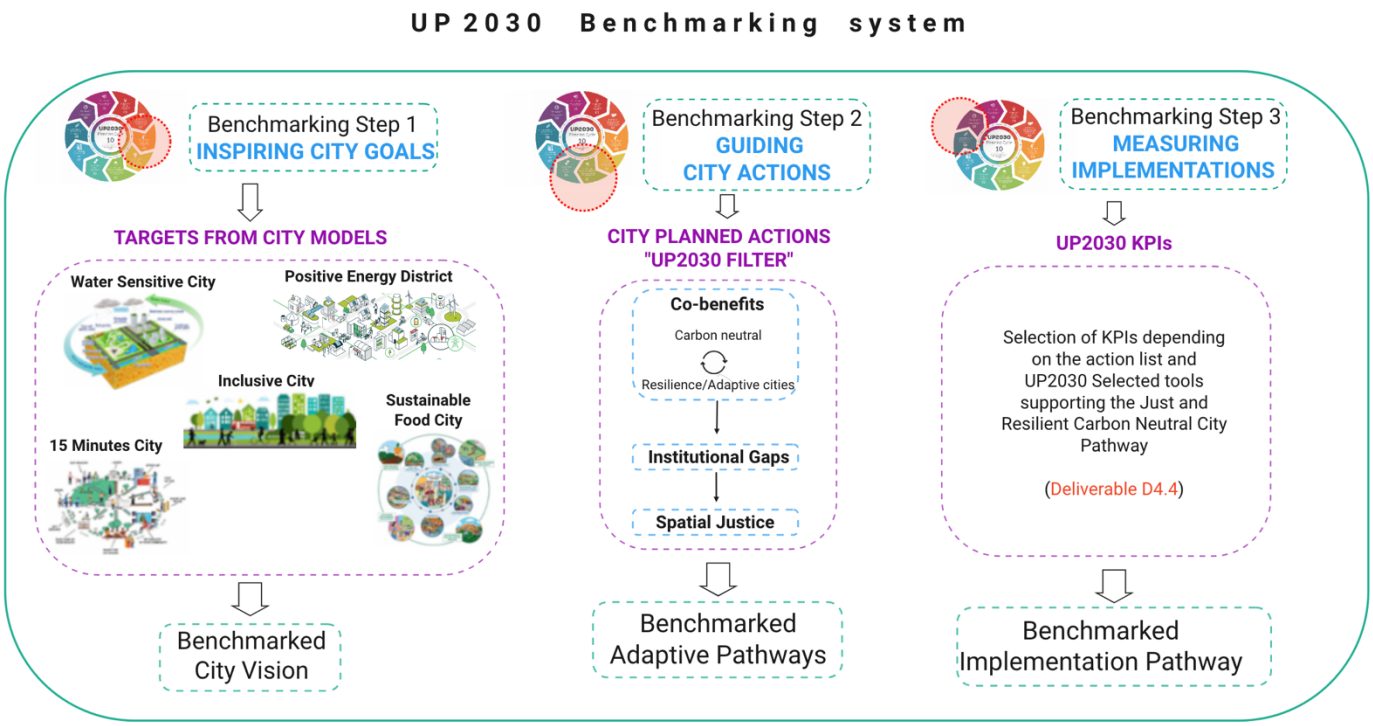

Figure 4: UP2030 Benchmarking system

The three concepts of the frameworks are independent but could also be used as a step-by-step process along with a planning process.

First step:

The first step aims to inspire cities as they elaborate their ambitions and cities' visions (in plans or cities' agendas). The benchmarking proposes a list of city models with their characteristics, to equip cities with a valuable and updated reference to enhance their visions and ambitions.

Second step:

The second part of the benchmarking focuses on cities' plans and policies framing, looking at and guiding carbon-neutral, resilient, and just transition actions. For that, different actions will be asked through what is defined as the "UP2030 Filter" (see part 4.3). This filter comprises different phases with the following objectives:

- Evaluate the potential for co-benefits and trade-offs between the carbon neutrality and resilience approaches in every action proposed by a city.
- Assess whether the proposed actions address the governance gaps that have been identified in this report (see next section).
- Verify that the topic of spatial justice, the core pillar of UP2030, is considered in the implementation of any action.

Rather than discarding certain actions from consideration, the aim of this second step is to assist cities in refining their implementation plans based on a comprehensive evaluation, helping cities to design their adaptive pathways toward a spatially just and resilient carbon-neutral city.

Third step:

The third and last step of the benchmarking aims at measuring and assessing the implementation of cities' actions. Indeed, when cities are working on the implementation of some policy or plan, the indicators of the third part of the benchmarking works to assess: 1) the performances of the implementation, 2) the alignment, coherence, and consistency of the actions with the city visions and plans. However, as this step is not led by UIC (lead author of this report) but by another partner of the consortium, and because for developing this implementation part of the benchmarking the project needs to work on solutions, the list of KPIs of this third part will be developed along the second year of the project. Only then, the benchmarking framework will be completed. On the other hand, the first two steps of the benchmarking system will be more thoroughly explained in the fourth part of the deliverable.

Before elaborating this benchmarking, we investigated the state-of-the-art on existing benchmarking system. This is presented in the following section.

2 State-of-the-art on existing frameworks and benchmarking systems

This section provides an overview about which are the recent frameworks and benchmarking systems for the 3 topics of carbon neutrality, resilience, and just transition. Also, one of the efforts was to understand why cities are still so unsustainable and far from accelerating carbon footprint reduction. This has a strategic value for the whole project, which first steps were to identify cities' "needs" to unlock the transformations but also to establish which are the domains of actions through which the UP2030 benchmarking should align with.

The three sub-sections below explore: i) the main international frameworks and the private certification systems, ii) addressing carbon neutrality, resilience, and spatial justice, to have a first overview of their structure, and a synergistic understanding of these 3 pillars. Here, within this first draft deliverable, the deep understanding of the current cities' gaps toward carbon neutralities are explored. It allows to identify areas of actions that the project needs to address and where our benchmarking and indicators will focus their attention in putting targets for cities.

2.1 Existing frameworks

As part of the state-of-the-art, it has been considered important to identify the existing benchmarking systems implemented for the evaluation of the degree of urban sustainability at city level. The way an indicator is defined and designed depends on the outcome that is aimed to be obtained. To this end, existing methodological frameworks have been classified as follows:

- **Global policy frameworks**: created by international organisations, worldwide targets.
- **EU-centred policy framework**: frameworks addressed to EU countries, cities, and regions.
- **Private sector certification frameworks**: targeted mainly for the real estate and construction sectors.

For each framework, some specific principles and determinants define the scope of benchmarking indicators. The review of these frameworks consists of identifying how they integrate assessment criteria for decarbonisation, resilience, and just transition in urban planning and design. The methodologic approach to classify the indicators according to their contribution to each pillar followed these criteria:

- Classification of the scale of incidence (global, EU level, private sector, networks, and academia). The final selection of frameworks is based on their relation to urban planning decision-making processes.
- Indicators contributing to the carbon neutral city pillar where those that have a direct incidence on the reduction of GHG emissions and resources consumption (energy, water, materials), and the carbon markets/trade. It encompasses any indicator that addresses GHG emissions mitigation.
- Indicators contributing to the resilience pillar including those that enable mechanisms to strengthen the capabilities of urban systems and build infrastructures or services with anticipation.
- Indicators contributing to the just transition pillar, which considered the socio-economic needs linked to people's livelihood and vulnerable groups.

- Indicators that integrate at least two of the three pillars were considered as integrated. Most of the cases found were mitigation indicators (carbon neutral) or adaptation indicators (resilience) from a just or inclusive perspective.

Once having the share of contributions, for each framework a percentage of indicators to each pillar are collected and compared. The results are complemented with the Annex 2 Existing Benchmarking Frameworks at the end of this document.

2.1.1 Global policy framework

These frameworks are the most used, cited in the literature or used by cities, and created by international organisations to respond to a worldwide benchmarking. The benchmarking of global policy frameworks allows us to estimate the advances at a country level and serve to see the country-based impact in their decarbonisation pathway.

Sustainable Development Goals (SDGs)

The SDGs[2] reframed the previous Millennium Development Goals, setting the bases for indicators seeking to recognise that eradicating poverty in all its forms and dimensions, including extreme poverty, is the greatest global challenge and an indispensable requirement for sustainable development (UN, 2015). The framework is structured by indicators for the 17 goals and 126 indicators. The scale of measurement is usually at country level, but there are some indicators provided by cities as well. After reviewing all indicators, the ones which are clearly addressing carbon neutral, resilience, and spatial justice are identified. After analysing the total of the indicators of the SDGs, the key findings are the following:

- 9,5% can be addressed to carbon neutral targets.
- 13,5% have a contribution to resilience capacity.
- 31,7% have a contribution to just transition.
- 45,2% of the total indicators have a potential integrated approach of the three pillars.

A few goals are addressing carbon neutral objectives, however there are much more integrated indicators combining mainly resilience and just transition objectives. The description of the indicators is in Annex 2 (Table 5). Some of the indicators should be adapted to fully accomplish the principles of each pillar, but 57 of the overall indicators could bring the opportunity to consider the integrated way of the 3 pillars.

New Urban Agenda (NUA)[3]

This framework was launched by the United Nations in 2016 during the Habitat Conference in Quito. The NUA represents a shared vision for a better and more sustainable future, encouraging a well-planned and well-managed urbanisation, with a special attention to developed countries (UN New Urban Agenda,

[2] https://unstats.un.org/sdgs/dataportal/countryprofiles/grc

[3] https://data.unhabitat.org/pages/new-urban-agenda

2016). The assessment framework[4] consists of a total of 77 indicators. The review identified that these indicators address the three pillars as follow:

- 8 can be addressed to carbon neutral objectives (10,4%)
- 15 can be addressed to resilience objectives (19,5%)
- 15 can be addressed to just transition (18,2%)
- 5 indicators present an integrated approach (11,6%)

Only 43 of the 77 indicators have a clear contribution to any of the three pillars (54,5%), it is therefore necessary to reinforce the assessment of mitigation and carbon neutral achievements. Resilience and just transition are better represented due to indicators assessing the robustness of infrastructures and services, and the impact on people's livelihood and health. (See table 6 in the Annex).

Organisation for Economic Cooperation and Development (OECD) Better Life Index

This framework of the Better Life Index[5] was launched by the OECD in 2011 with the aim of providing statistics on well-being by country through quality of life and material living conditions. The index is structured by 24 indicators organised by 11 domains: *Housing, Income, Jobs, Community, Education, Environment, Civic engagement, Health, Life Satisfaction, Safety, and Work-Life Balance.* From the total 24 indicators:

- 9 indicators (37,5%) are related to resilience.
- 7 indicators (29,2%) are related to just transition.
- 2 indicators (8,3%) are related to carbon neutral.
- 6 indicators (25%) have an integrated approach of just transition and resilience.

It is an interesting framework when considering its transposition at the local level, which could allow the comparison of its results between countries. In any case, what is missing is the integration of the carbon neutral dimension; only a couple of indicators are linked to the environment (air pollution and water quality) (see table 7 Annex 2).

There are other relevant frameworks at the global level, such as the Human Development Index[6] from the UN Development Programme and the Global Liveability Index[7] from the Economist Intelligence Unit provide indicators and dashboards on aspects related to living conditions and environmental impacts.

[4] https://www.urbanagendaplatform.org/themes/custom/habitat/assets/Development_of_NUA_Monitoring_Framework_and_related_indicators_v1_1_March_2021.pdf

[5] https://www.oecdbetterlifeindex.org/#/11111111111

[6] https://hdr.undp.org/system/files/documents/global-report-document/hdr2021-22pdf_1.pdf

[7] https://www.eiu.com/n/campaigns/global-liveability-index-2021/

2.1.2 EU initiatives and policy frameworks

These frameworks correspond to those defined and encouraged by the EU Commission; their aim is a political vision of carbon neutrality, with the establishment of the minimal requirements in terms of regulatory frameworks.

EU Green Deal

In 2015, at the 21st Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC), 55 Parties adopted the Paris Agreement, committing to communicate their mid-century, long-term low GHG emission strategies. The EU Parliament endorsed the EU Green Deal in January 2020 stepping forward EU State Members, committing to the ambitious objective of becoming carbon neutral by 2050 without leaving anyone behind. The EU Green Deal defines a holistic approach for a carbon neutral strategy, involving all consumption and production sectors, and giving special attention to circular economy, biodiversity and just transition.

The EU Commission has launched a dashboard with statistics around the implementation of the EU Green Deal actions and policies. The dashboard is structured by 25 indicators organised in three domains: *Reducing (our climate impact), Protecting (our planet and health) and Enabling (a green and just transition).* The review of all indicators shows that there is a more distributed contribution to the three pillars as follows:

- 8 indicators (32%) are related directly to carbon neutral actions.
- 7 indicators (28%) are related to resilience actions.
- 2 indicators (8%) are related to just transition actions.
- 8 indicators (32%) present an integrated approach.

In this case, the framework presents an interesting structure of domains that pay attention to integrated indicators between carbon neutral and just transition pillars (see Table 8 in Annex 2). However, a stronger just transition assessment is still missing. It is worth to mention that it would be recommended to use at city level, due to the possibility of benchmarking at the national and local levels.

Fit to 55 Package

Fit to 55 refers to the EU's target of reducing net greenhouse gas emissions by at least 55% by 2030. The proposed package aims to bring EU legislation in line with the 2030 goal. According to the measures presented by the EU Commission, the package aims to encourage the implementation of a coherent and balanced framework for reaching the EU's climate objectives. The working areas proposed by the Fit 55 package are:

- Renewable Energy – Energy Efficiency – Energy Taxation.
- CO_2 emission standards for cars and vans.
- Refuel EU aviation and fuel EU maritime.
- Social climate fund.

- Carbon border adjustment.
- Alternative fuels infrastructure.
- Land use and forestry.
- Efforts sharing regulation.
- EU emission trading system.

This package could be accelerated by two international contextual events triggering the potential of a systemic (European) sustainability transition: the post-COVID-19 de-centralization patterns and the energy crisis due to the Ukraine War. From one side, among the many post-pandemic urban and lifestyle trends there has been an increasing willingness to better balance work-life and urban-nature exposure (Samuelsson et al., 2020), which implied a certain degree of people leaving big cities while moving and sprawling across regions' towns and villages (Ramani & Bloom, 2021), while from another side, the emphasis of the inadequate living conditions experienced during the lockdown in many peripheries supported the new (re-labelled from TOD – transit Oriented Development US' planning design concept of the '70) 15 Minutes city, aiming at clustering services and good infrastructures in each city district. These initiatives aiming at a better linkage between urban life and nature, saw in the Ukraine war and Europe's dependency on Russian' gas a further push toward decentralizing our infrastructures, trying to decrease the dependency from Russia, and fostering local renewable resources.

Clean energy package – Climate action plans

The EU has started its roadmap for decarbonisation through the Clean Energy package (EC, 2019)[8] to encourage the increasing presence of renewable energies in the energy mix and enhance energy efficiency. The transposition of this directive to all EU Member States, incentivized the preparation of National Energy and Climate Plans and their corresponding action plans at the regional and local levels. As a result, and together with the Covenant of Mayors (CoM) Initiative[9], energy and climate plans begin to be part of the political agenda of thousands of municipalities.

New European Bauhaus (NEB)

The NEB is an initiative launched by the EU Commission to encourage the integration of beauty in the green transition. The NEB Compass[10], is a tool guide structured by three principles: *Beautiful, Sustainable and Together*; and three working principles: *Transdisciplinary approach; Multilevel engagement; and Participatory process*. In this case, the benchmarking is conceived by assessing the level of alignment of a project to those principles and values through "ambitions" accomplishment. The scope of the NEB values and working principles have a clear contribution to the resilience and just transition pillars. If carbon

[8] https://extranet.acer.europa.eu/en/Electricity/CLEAN_ENERGY_PACKAGE/Pages/Default.aspx

[9] https://eu-mayors.ec.europa.eu/en/home

[10] https://new-european-bauhaus.europa.eu/system/files/2023-01/NEB_Compass_V_4.pdf

neutrality is represented by the sustainable value, it is properly addressed in the circular economy and low-carbon emission solutions developed by the NEB:

- 2 ambitions addressed to carbon neutral (11%)
- 6 ambitions addressed to resilience (33%)
- 2 ambitions addressed to just transition (11%)
- 8 ambitions addressed to integrated pillars (44%)

In Annex 2, table 9, the different principles and implementation criteria are described and their contribution to each pillar accordingly.

2.1.3 Tools and assessments to measure carbon neutrality

While there is no actual benchmarking system for resilience (only indexes), nor for spatial justice, many tools and assessments exist for carbon neutrality, that can evaluate and benchmark the progress towards carbon neutrality, both at the city building scales.

Carbon neutrality assessment at city scale

A few tools exist to assess GHG emission at city scale. They have been summarized below by Cambridge University.

Global protocol for community-scale greenhouse gas inventories (GPC):

The leading standard for cities to account their carbon emissions is the GPC was developed in collaboration between the World Resources Institute, C40 Cities, and ICLEI; which was recently updated in 2021. This standard provides a means for cities to primarily account for their carbon emissions through the creation of greenhouse gas emissions inventories, and details various approaches throughout for cities to account for their emissions. Within, the 'city' is separated into five different emission categories (sectors) – *Stationary Energy, Transportation, Waste, Industrial Processes and Product Use (IPPU)* and *Agriculture, Forestry and Other Land Use (AFLOU)* (plus other scope 3 emissions) – and the parameters for assessing scope 1, 2 and 3 emissions are covered. At the city wide level, different users of the standard can identify the depth of analysis the wish to pursue by opting for either a *basic* approach, which "covers emission sources that occur in almost all cities (Stationary Energy, in-boundary transportation, and in-boundary generated waste) (GPC, 2021, p39) or *basic+,* which expands upon the *basic* level by incorporating "IPPU, AFOLU, transboundary transportation, and energy transmission and distribution losses" (ibid). Within this standard, the quality of data is ascribed to that of the *GHG Protocol Corporate Standard* (created by the same entity), namely any data included should be grounded in principles of R*elevance, Completeness, Completeness, Transparency* and *Accuracy* (ibid, p29). Within each emission category, a detailing of calculation approaches and potential data sources is discussed, with an emphasis upon proxies and means of working out emissions if the data is lacking.

SCATTER

SCATTER is a "local authority focused emissions measurement and modelling tool, built to help create low-carbon local authorities" (SCATTER Cities, 2023). Developed by the department of Business, Energy and Industrial Strategy in league with Nottingham City Council and the Greater Manchester Combined Authority, the tool supports users in creating GHG inventories and through creating pathways to reduce their carbon emissions. SCATTER stands for *Setting City Area Targets & Trajectories* for *Emissions Reduction* and uses the GPC standard to inform this. An interesting element of SCATTER is the ability for users to model future emissions I the Excel based, SCATTER Pathways tool. This is conducted through choosing from 5 pre-set scenarios combining over 30 interventions to model future emissions, which enables users to compare emission scenarios against their own targets as well as in relation to the Paris Agreement. In turn, this is to structure an understanding of the scale of action needed to work towards a city's emission reduction goals, whilst building an evidence base for their climate strategy and action plans (ibid). These insights are also visualised within the tool to assist in sharing information about the city's work towards carbon neutrality with a broader audience.

Local Government Agency's Greenhouse Gas Accounting Tool

The Local Government Agency's Greenhouse Gas Accounting Tool is an Excel based tool which can be used to record council e–issions - both Scope 1 and 2, plus basic Scope 3 emissions. This tool "produces summary tables and charts to help local authorities understand their most significant sources of emissions, which can then be used to prioritise actions to reduce carbon emissions" (Local Partnerships, 2023). This is centred around automatically linking city emission data with relevant UK Government Conversion factors, in order to take away some of the burden of the calculations – a potential barrier preventing wider reporting of urban carbon emissions. For the tool to be appropriately utilised, users (city councils) will need "gas and electricity consumption (expressed in kWh) as well as details on the amount of other fuel consumed by [their] buildings (for example oil or liquefied petroleum gas) and […] fleet vehicles (type of vehicle and fuel, plus amount of fuel used/mileage)" (LGA, 2023). Further 'ideal' information to be included includes data on leaks/top ups to the amount of gas in air conditioning systems, so fugitive emissions can be accounted for.

Carbon neutrality assessment at building scale – Private sector certification

Alternatively, once the scale is reduced, it is possible to find specific benchmarking systems, at the building level. These frameworks are created by the private sector with the aim to verify and validate products, services, and processes. The assessment methodology and rating scope are conceived to ensure the quality of a project as a final product (building/neighbourhood) enhancing its competitiveness in the market and accomplishment of green standards. Currently, there are several certification systems, especially in the building and construction fields. Beyond green standards, some of these rating systems are looking to integrate the human and community dimensions by including health and quality of life to the standards. Two certification systems are particularly relevant and are presented below.

BREEAM[11]

The certification stands for "Building Research Establishment Environmental Assessment Method" and forms part of the bregroup[12], one of the most well-known organisations dedicated to the development of certification systems in construction with more than 100 years in operation. The BREEAM certification allows for assessing projects at building and neighbourhood scales. The analysis considered the benchmarking framework used in Spain to analyse the contribution to the three UP2030 pillars. The benchmarking structure has 8 domains: *Climate and energy; Community; Design of the place; Ecology; Transport; Resources; Economy and Buildings;* 35 subdomains and 62 indicators covering water, energy, materials, and also provision of facilities. According to the scope of the indicators, here is the share of contributions:

- 11 indicators contribute to carbon neutral city (17,7%)
- 29 indicators contribute to resilience (46,8%)
- 14 indicators contribute to just transition (22,6%)
- 4 indicators present an integrated approach (6,5%)

In Table 10 in Annex 2, the indicators are described. In this case, there is a higher contribution to resilience, but there is a wider incidence on carbon neutral topics with respect to the other frameworks.

LEED for Cities and Communities[13]

The Leadership in Energy and Environmental Design (LEED) certification was launched in 1993 by the US. Natural Resources Defence Council supported by the US. Green Building Council. Since then, several certification systems have been developed with a wide consensus of private and public stakeholders including academia. Although they started focusing mainly on buildings, LEED neighbourhood was launched in 2009 to integrate their rating systems for the design, construction and operation of buildings, homes, and neighbourhoods. Nowadays, the certification has been extended to countries around the world, and it is granted by the World Green Building Council. As for the analysis, the rating system for Cities and Communities is considered, which is structured by 40 indicators distributed by the following 9 domains each with a different weight within the overall rating: *Integrative process (5%); Natural systems and ecology (8%); Transportation and land use (14%); Water efficiency (10%); Energy and greenhouse emissions (27%); Materials and resources (9%); Quality of life (18%); Innovation (5%); and Regional Priority (4%).* The system gives more relevance to decarbonisation actions and liveability conditions, more than just transition actions. According to the analysis, the contribution to the UP2030 pillars is:

- 13 indicators contribute to carbon neutral city (32,5%)

[11] https://tools.breeam.com/projects/

[12] https://bregroup.com/products/breeam/breeam-solutions/

[13] https://www.usgbc.org/leed/rating-systems/leed-for-cities-communities

- 13 indicators contribute to resilience (32,5%)
- 8 indicators contribute to just transition (20%)
- 6 indicators have an integrated approach (15%)

The description of the indicators and the corresponding classification according to their contribution to each pillar are in Table 11 in Annex 2.

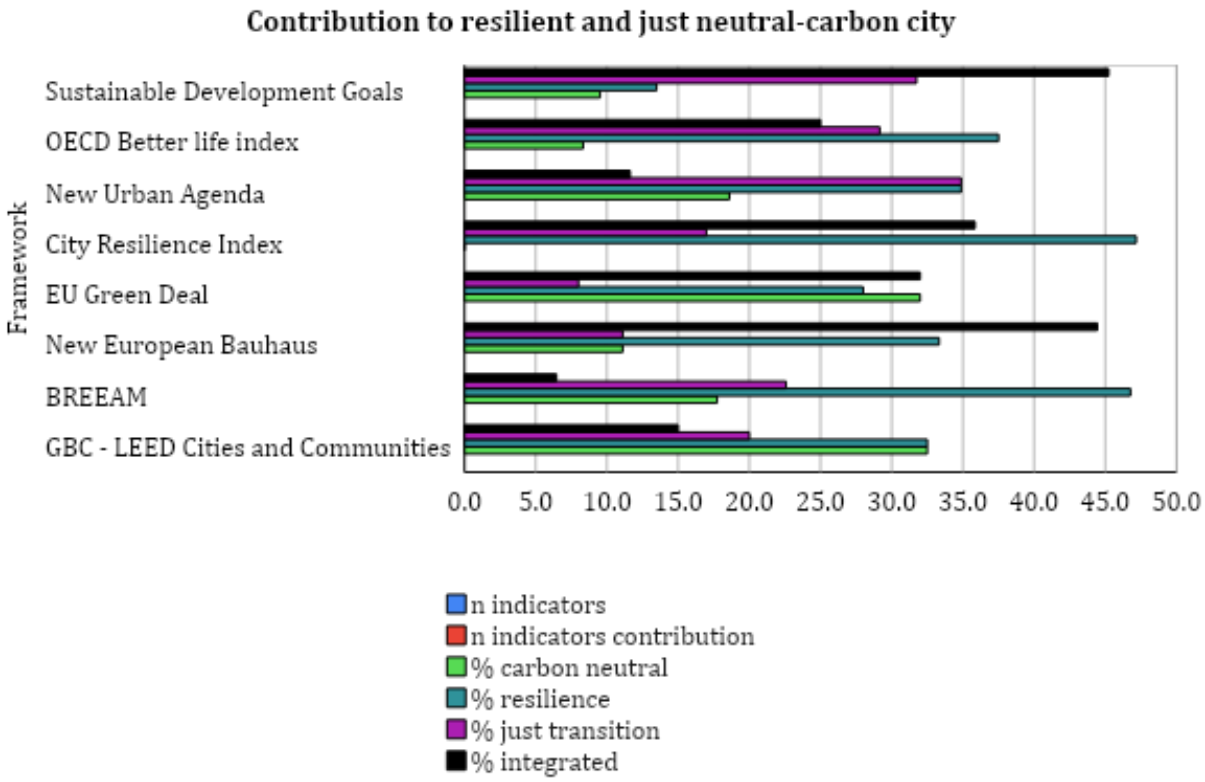

Figure 5: Existing benchmarking frameworks contribution to UP2030 pillars. Source: UIC based on the information published by each organization.

Figure 5 shows an overview of the level of contributions to the three pillars, most of the indicators commonly contribute to resilience, in a few to just transition, but what is clearly a lower contribution is to carbon neutral city actions. Several frameworks present potential integration between two pillars, but there are no clear contributions to the three pillars within an indicator.

2.2 State-of-the-art of specific topics

A comprehensive benchmarking system necessitates the development of characteristics and indicators tailored to diverse urban topics. Therefore, technical partners of UP2030 prepared a state-of-the-art about

their field of expertise and explained how their topic contributes to carbon neutrality, resilience, and spatial justice. The following section presents the partners' contributions.

2.2.1 Urban Heat Island Effect

According to the European Environmental Agency (EEA) he potential for dangerous exposure to extreme heat has escalated over recent decades[14].
Such exposure can lead to direct consequences like heat stress and dehydration, as well as indirect impacts such as exacerbating cardiovascular and respiratory conditions, kidney disorders, and electrolyte imbalances. The immediate and subsequent three-day period are when the direct effects of heat are most pronounced (WHO Regional Office for Europe, 2018). On a global scale, in 2019, vulnerable populations faced an additional 475 million exposures to heatwave events, resulting in an alarming surge in both sickness and fatalities (Watts, et al., 2020).

Contribution to carbon neutrality: The urban heat island effect is a direct consequence of intense human activities, which inevitably release carbon dioxide into the atmosphere. City awareness of this effect leads to a more conscientious use of land and less climate-impacting practices. **An urban policy approach that considers the effects of this phenomenon, directly and indirectly, contributes to emissions reduction**, making the goal of climate neutrality achievable.

Contribution to resilience: The city sectors emitting substantial heat due to their activities are major contributors to the formation of heat islands. Alongside this, the presence of urban environments lacking adaptive design exacerbates liveability challenges during extreme heat conditions. Furthermore, both intrinsic socio-sanitary conditions and extrinsic factors aggravated by heat are key considerations. **These factors are all part of the assessment framework for identifying areas in urgent need of adaptation**, where intervention priority is imperative to prevent critical impacts on the resident p'pulation's well-being. Understanding how to make architecture and infrastructure in cities more resilient to heat is now a central focus of a wide range of research. It must be acknowledged in any urban planning strategy that not all citizens in a given urban area may be equally affected by the same heat stress condition.

Contribution to spatial justice: The socio-economic inequality within urban spaces is a central theme of study regarding the effects on populations exposed to heatwaves in cities. In fact, many social groups reside in housing conditions without nearby services, which exacerbates difficulties and hardships during episodes of extreme heat. When considering variables related to social status, it **has been highlighted that intra-urban temperature variability due to social factors (e.g., social isolation), cultural factors (e.g., ethnicity), and economic factors (e.g., lower income/education) are important determinants**, along with characteristics of the indoor and outdoor environment contributing to exacerbating heat stress conditions respectively (S.D. Arifwidodo, 2020).

[14] https://climate-adapt.eea.europa.eu/en/eu-adaptation-policy/sector-policies/urban/index_html#:~:text=A%20prevalence%20of%20built%2Dup,urban%20floods%20during%20heavy%20rains.

2.2.2 Ecosystem Services Assessment

Originally, the concept of ecosystem services primarily emphasized environmental benefits, such as clean air and water, while neglecting their social dimensions. As such, the conceptualization of ecosystem services separated the ecological sphere, where ecological functions occur, from the social sphere, where benefits are received. Only in the **Millennium Ecosystem Assessment** in 2005, cultural services, defined as the non-material benefits people obtain from the ecosystem, have been included together with provisioning, regulating, and supporting services. Nowadays, it is fully recognized the intricate interdependence of diverse spheres. It recognizes that services derived from nature exert a multi-dimensional influence on the environment, economy, and the identity of communities. This evolved conceptualization requires a clear identification of ecosystems and their beneficiaries, which are often represented spatially. In recent years, municipalities have proactively developed tools to co-produce benefits from human interventions. Green roofs, parks, bike lanes, blue infrastructures, all provide a set of benefits to humans that need to be addressed holistically and through a transdisciplinary approach. **To fulfil an assessment of all the benefits derived from ecosystem services, many municipalities are now using the ecosystem service assessment** (Everard & Waters, 2013). This approach systematically evaluates the various benefits ecosystems provide to humans, combining social, environmental, and economic benefits into a unified framework (Spooner et al., 2021). This is critical for evaluating interventions aimed at creating a resilient and socially inclusive city. Indeed, it quantifies how urban ecosystems contribute to reduce air pollution, foster social inclusivity and access to green spaces, manage water retention, support biodiversity, and so on. All these results provide vital data for informed decision-making and ongoing monitoring of progress.

Contribution to carbon Neutrality: The ecosystem services assessment plays a significant role in achieving carbon neutrality for cities by **helping to understand and quantify the carbon sequestration, air and quarter quality, and biodiversity conservation provided by natural ecosystems.** It is important to notice that the concept of carbon neutrality can vary depending on regional and local contexts. However, a notable framewor“ is the "Carbon Neutrality”Standard" developed by the Greenhouse Gas Protocol, which is widely recogn“zed globally for measuring”and managing GHG emissions and can be addressed through the ecosystem se“vice assessment.

Contribution to resilience: The concept of resilience focuses on complex systems to deal with change, uncertainty, and shocks. In this context, cities are seen as complex adaptive systems and interventions occurring as changes in the equilibrium. One of the salient elements is to address these challenges by elaborating scenarios that focus on the relationships between sub-systems. The ecosystem services assessment addresses these interactions between agents and is built upon the recognition of changing dynamics. Besides, the tool provides a set of alternative scenarios that combine the deriving benefits, for example by comparing decentralized with centralized structures, thus, understanding which interventions most likely achieve better resilience in the short, medium, and long terms (Hamel et al., 2021).

Contribution to spatial justice: In recent years, the benefits from ecological restoration have merged with concepts such as social justice and equity. The ecosystem services assessment fulfils this goal by ensuring that all i**ndividuals and communities have access to the benefits of ecosystems, such as clean air and water, green spaces, regardless of their socio-economic status**. This supports the goal of a just and equitable urban environment where everyone can enjoy a high quality of life.

2.2.3 Air quality monitoring and forecasting

Air quality is a pivotal indicator of public health and overall quality of life. In recent years, the significance of air quality has gained prominence as cities worldwide embark on a collective journey toward achieving carbon neutrality, resilience, and social justice. While the practice of monitoring air quality within urban environments dates to the middle of the last century, early air quality monitoring systems were notably constrained in their scope and precision (Zhang et al., 2012).

Recent years, however, have witnessed substantial advancements in air quality monitoring technology, marking a pivotal milestone with the development of cost-effective air quality sensors. These sensors, characterised by their compactness, lightweightness, and affordability, have proven to be well-suited for deployment within densely populated urban areas. Notably, these sensors have substantially enhanced the precision of pollutant measurement, facilitating the comprehensive evaluation of a wider range of pollutants, including particulate matter, nitrogen dioxide, and ozone. Furthermore, the advent of satellite-based air quality monitoring systems such as Copernicus Sentinel 5-P represents another significant leap forward. These systems can provide air quality monitoring across extended areas, even encompassing remote regions that may remain beyond the purview of conventional ground-based monitoring networks.

Despite these notable strides in air quality monitoring technology, challenges persist that warrant our attention. First and foremost, **achieving air quality monitoring with a high spatial resolution is essential for comprehending the intricacies of pollution dynamics within urban domains**. Although conventional monitoring networks are undeniably valuable, their granularity often falls short of capturing the nuanced fluctuations in air quality that can arise even within a single urban setting. Factors such as traffic congestion, industrial activities, topographic attributes, and land use in general can cause conspicuous disparities in air pollution. This challenge underscores the need for technology and methodologies capable of affording finer spatial granularity. Secondly, **accurate forecasting of pollutant levels for the upcoming days holds paramount importance for proactive urban management and the overall well-being of city inhabitants**. The intricacies involved in precise air quality forecasting are multifaceted, encompassing meteorological variables, emission sources, and the dispersion of pollutants. Ensuring reliable forecasts empowers cities to implement timely measures to safeguard public health and mitigate the environmental impact of air pollution.

Traditional, domain-specific approaches to air quality forecasting have historically centred around chemical transport models. These models aim to depict the complex chemical and meteorological processes occurring within the atmosphere, specifically emphasising emissions, and formulate corresponding mathematical representations (Konovalov et al., 2009).

Artificial intelligence (AI) has recently emerged as a pivotal asset to address these challenges. AI technologies can proficiently handle the substantial volume of the required data, using historical data to discern intricate trends and patterns. This capability facilitates a more advanced comprehension of pollution hotspots, their temporal fluctuations, and underpins the delivery of more reliable and timely forecasts. AI statistical methods predominantly rely on identifying statistical relationships between various factors and air pollutants in temporal sequences. Leveraging historical data, these methods facilitate air quality predictions without necessitating a comprehensive comprehension of the dynamic and chemical interplay between air pollution levels and other relevant variables within the atmosphere. This holds true for AI and machine learning methodologies, which have garnered substantial attention in recent years,

particularly in the context of air quality forecasting (Zhang, Bocquet, Mallet, Seigneur, & Baklanov, 2012)
.

2.2.4 Climate Economic Modelling

Strategic planning and defining emission reduction pathways must be based on scientific evidence and robust methodology for forecasting emission reduction and the related socio-economic trends and effects. **Background analysis of decarbonization pathways in the form of climate economic modelling is an essential element in planning for decarbonization**. As an example, in the Hungarian long-term climate strategy (LTS) in order to outline the long-term trajectory of emission reduction scenarios, an integrated modelling approach was used to explore the specificities of the sectors as well as the system-wide and cross-sectoral dynamics of the decarbonization process.

Climate economic modelling quantifies the links between climate change and the economy of a country, informing policymakers of the costs, benefits, and effects of both climate change and decarbonisation. In predicting the impacts, costs and benefits, estimates show significant variations. This is due to, among others, the diversity of approaches used to focus on different sectors and using different assumptions (e.g., on economic growth, on demographics, on climate risks and impacts), uncertainties associated with both future climate change and economic growth in the long-term, and the diversity of economic contexts (both local and national). The added value of economic modelling is that it indicates of expected impacts on the economy.

Current developments in the area of climate economic modelling:

- Combining various knowledge from different disciplines (e.g. atmospheric science) to analyse interconnections between the environment, the economy, and the climate.
- Incorporating environmental risks and hazards (e.g. sea level rise).
- Some models also account for technological advancement as a direct result of economic decisions (not only view is at an exogenous factor).
- Incorporating spatial justice and equity through analysing the different impacts of climate change on different groups of people (ethnicity, lower-income areas etc.), and regions.
- Incorporating cost-benefit analysis of adaptation activities (e.g. coastal protection).
- Holistic system approach: combining and integrating insights from other disciplines and models, enhancing the model to reflect real-world complexities.

In earlier modelling the focus was on broader national or global scales, with cities being part of aggregated data**. Recently more detailed city-scaled models have been developed to capture local contexts and to allow the development of urban policies and decision-making**. Previously, both in economic and social terms urban activities were treated as aggregate, overlooking diversity and intra-city disparities. **Localised models can give greater attention to the distributional effects of climate change within cities, recognizing that vulnerable populations (e.g., informal settlements) often face heightened risks**. Participatory approaches are also increasingly popular by involving local stakeholders in planning as opposed to top-down modelling and scenario planning.

In the area of economic modelling, **marginal abatement cost curves (MACCs)** are a widely applied tool that assesses the abatement potential and the economic costs of mitigation measures and provides a prioritization based on their marginal abatement costs, **enabling users to select priority climate actions** (as choosing the lowest abatement costs indicates that emissions can be avoided or reduced at a low cost).

However, this is a tool designed to reduce marginal emissions, thus it is not a solution for radically changing modes of operation (as sometimes hard-to-abate emissions come at a higher cost.) Moreover, technologies continuously evolve with innovation and investment, making it a challenge for decision-makers to determine which technologies to support or rule out.

Existing tools can be altered and expanded to account for local, city-wide contexts to (1) plan or monitor local policies and investments (by assessing their impact within and across sectors, and for social, economic, and environmental indicators at city-level); and (2) inform urban development planning (by assessing the outcomes of the simultaneous implementation of various intervention options). Increasingly, models account for urban infrastructure as a solution to climate change mitigation and adaptation, rather than a static variable in modelling. Modelling helps to overcome some of the limitations of the first generation of urban MACCs (with a strong focus on costs not taking into account distributional effects or technological advancements; ignoring co-benefits; lack of spatial dimension; ignoring inter- and intersectoral interactions).

2.2.5 Participatory GIS

Stakeholders' engagement is a critical component of achieving a just transition to net zero and one of the fundamental challenges is meaningfully engaging the diversity of stakeholders involved, including governments, businesses, workers, local communities, and civil society. Engaging these diverse groups effectively requires a multi-faceted approach using innovative, accessible methods.

Participatory GIS (PGIS) is a powerful tool to engage stakeholders, gather and analyse local knowledge and focus the discourse on local issues. The practice was developed to provide the public with access to information and technology i.e., GIS being used by authorities and large corporations. **This approach aimed to reduce the risk of marginalising communities and individuals in important decision-making processes** (Haklay & Francis, 2018).

Significantly, the rapid adoption of digital technologies in recent decades has further widened the opportunities for public participation; as smartphone and computer ownership has become ubiquitous, barriers to engagement have reduced. In other words, communities **can utilise digital mapping technologies to improve understanding of specific topics and to ensure that the needs of local residents, particularly those who are marginalised or most affected by interventions, are acknowledged and addressed.**

PGIS can facilitate collaboration and co-design, leading to more acceptable and sustainable outcomes; and improve transparency, which is crucial for building trust among stakeholders. Through engaging underrepresented and marginalised groups, PGIS can also promote inclusivity, ensuring these voices are heard and documented. **Participatory mapping and PGIS are based on the principle of empowerment through participation** and when conducted well should be flexible, adaptive, and ongoing whilst respecting and utilizing local knowledge (McCall, 2014).

PGIS can be conducted using paper maps at face-to-face events, but also online using accessible GIS-based programmes. Both approaches have their benefits and drawbacks. In person participation may generate more interest and open productive discussion but is also limited by the scale and area covered by the printed maps. Conversely, online maps have fewer limitations of scale and boundaries and can be shared more widely to attract demographics who usually might not be directly engaged. A note of caution is given by Calvert & Jahns (2021), citing Moss et al. (2014 and Pitt & Bassett (2013), that **participatory mapping should be coupled with other interactive engagement activities, such as group dialogue where concerns and queries can be aired, and any misconceptions addressed in order for the map outputs to have greater legitimacy.** In practice, Mapping for Change has used a mixed approach to capitalise on the benefits of both offline and online participatory mapping. Initially, engagement is conducted face-to-face to explain the scenario and provide access to existing information about the subject. At this stage, paper maps are used to open discussion and set priorities. The findings are then coded and digitised on the interactive Community Maps platform which can then be shared among the wider community through various social and community channels. Community members and other stakeholders can then see what has been identified so far and contribute their own ideas, knowledge, or perceptions to the map, using a structured data collection form. This combined approach to interactive engagement supports relationship building for the future.

For cities looking to adopt PGIS into their ongoing processes, much can be learned from Raminez Aranda et al. (2023, pp. 11) who among identifying **barriers to the adoption of PGIS,** such as willingness to participate and trust in the process, state that "finding or cultivating internal, bureaucratic champions is a prerequisite for wider use of participatory mapping by authorities and adoption by the public".

2.2.6 Decarbonizing buildings and transport systems

Buildings are significant consumers of energy, resulting in high CO_2 emissions. Efforts are being made in many cities to reduce buildings' energy consumption through improvements in energy efficienIe. facade improvements, higher efficiency energy systems) and the on-site deployment of renewables (i.e. photovoltaics). Existing efforts include net-zero carbon and net-zero energy building standards (Passivhaus, LEED, BREEAM, Green Star or local Net Zero Energy Building Certification programs). Moreover, during on-site energy generation from building-integrated photovoltaic, there is an untapped potential to use surplus energy in other urban services, i.e. electric transportation. To support urban-scale decision-making and evaluate what-if scenarios, it is necessary to systematically analyse buildings and photovoltaic (PV) system energy balance through modelling and simulations. Existing modelling tools currently do not provide comprehensive solutions on the urban scale.

Transportation is one of the major consumers of energy, accounting for ~25% of world energy use, often supplied with fossil fuels. Decreasing this significant energy demand is one of the challenges for all countries. Electric vehicles (EVs) provide opportunities for reducing dependency on fossil fuels and using the energy that can be obtained from natural resources, especially the sun. However, as it is difficult to store the extra energy that can be produced by PV panels, it is preferable to match the energy demand by the EVs with the energy supply by the PVs online, dynamically. This challenge has attracted the attention

of many in the literature. However, currently, there are no tools that can be used to match the demand and the supply for any city or any EV platform.

The Nano-grid and microgrid concepts (combination of building(s), generation, batteries, and electric vehicle) are some of the key factors of the net-zero approach and carbon neutrality. There are six major standards for nano-grid operation and integration. The International Electronical Commission (IEC) 62898-1 defines the technical requirements and guidelines for the planning stage, while IEC 62898-2 provides the principal requirements for components, operation, and transitions. The Institute for Electrical and Electronical Engineers (IEEE) 1547.4 and its updated version IEEE 1547-2018 present a reference for the design, operation, and transitions of distributed energy resources (generation and battery storage). The IEEE 2030.7 standard defines and specifies the control of NG as a critical element, which can operate autonomously. The IEEE 2030.8 is the standard to qualify, verify and evaluate the recommended specifications and functionalities.

3 Governance gaps in urban transformation

Why after many COPs (Conference of the Party) we are still far from a carbon-neutral transition? Why cities are still so unsustainable? There are uncertainties about the real achievement of carbon emissions reductions (Ulpiani et al., 2023). High political commitment has been achieved in recent years, although there are still gaps between strategies and actions, especially for transport and household consumption (Vanhuyse et al., 2023). Asking ourselves what the purpose of a benchmarking system is the key to justify why and how this benchmarking system has been thought of. UP2030 benchmarking system has been thought to provide standards reference points to cities to enable transformation, to accelerate sustainability transformations. Therefore, it is of outmost relevance to properly understand what the barriers are impeding urban transformation, to set the standards in the domains where barriers need to be overcome. This has a strategic value not just for this report, but for the whole project, which first steps are to identify "cities updating needs" in order to accelerate transformations.

The deliverable proposes here four thematic clusters of barriers cities face, to better understand where the "needs for upgrading" (the first project step along the 5 Ups approach) could be driving actions.

3.1 Institutional governance barriers

Exploring the literature, most of the governance barriers to accelerate urban transformations deal with the **lack of capacities** at the institutional level. Fragmentation of climate responsibilities, departments' silos, and inappropriate coordination among different administrative levels has been a common barrier highlighted by municipalities (NetZeroCities, 2022[15]). Indeed, **governance appears to be one of the most cited barriers** among others as technological, or economic (Schuch, 2021) in the implementation of smart and sustainable cities literature, notwithstanding the large political commitment among European countries to neutrality by 2050 (Ulpiani et al., 2023).

Looking at some data about climate stakeholders across the globe, the UNFCCC Global Climate Action Portal[16] has listed 19,387 city actors in European countries (as of 2023), resulting in an impressive 82% increase according to what was listed for 2020 (10,614 city actors). Scoring climate actions globally, the same source reports that the greater emissions reductions are mainly associated with plans targeting energy efficiency (Hsu et al; 2020). However, Houvila et al.(2022) reported that most of the literature about barriers enabling climate action focuses on the **gaps between strategy and implementation**. Most of them point to the lack of internal (institutions) and across governance levels, stating the need for aligning transition pathways, methods, and approaches in order to support a more system understanding and implementation mechanisms to enable needed transformations across sectors and scales (Houvila et al., 2022).

[15] Report on City Needs, Drivers and Barriers towards Climate Neutrality. https://netzerocities.eu/2022/04/22/city-needs-drivers-and-barriers-towards-climate-neutrality/

[16] https://climateaction.unfccc.int/Actors

3.2 Technological barriers

After the main institutional barriers, the area of technology is the second most important one. Achieving carbon-neutral cities requires the deployment of various low-carbon technologies. However, several technological gaps and barriers can hinder progress in this area (Reckien et al., 2023). Some of the key technological gaps and barriers for carbon-neutral cities include **"infrastructural requirements"** such as energy grids, charging infrastructure for electric vehicles, and energy storage systems working at scale and scalable in time and required size for a systemic transition (Schuch, 2021).

Outdated infrastructures and lack of reliable data and plans for understanding and planning for reliable energy future demand can be a barrier to the deployment of these technologies. Another **barrier is the grid integration**: integrating intermittent renewable energy sources, like solar and wind power into existing energy grids can be challenging because of the grid stability, load balancing, and energy storage capacity need to be addressed to ensure reliable and efficient integration of renewable energy.

Finally, **the limitation due to scalability** and replicability at the local level of specific technological applications could become a barrier. Some low-carbon technologies may be effective on a small scale or in specific contexts but face challenges when scaling up or replicating in diverse urban environments (NetZeroCities, 2022). The ability to scale technologies and adapt them to d'fferent cities' needs is essential for achieving widespread impact.

3.3 Economic barriers

Economic barriers can significantly impact the achievement of carbon-neutral city targets (World Benchmarking Alliance, 2019). These barriers are related to financial constraints, market conditions, and capacities to design marketable implementation plans. According to the OECD, some of the key economic barriers to carbon-neutral cities are **high upfront costs**, implementing low-carbon technologies and infrastructure often involves significant upfront costs for renewable energy systems, energy-efficient buildings, and sustainable transportation options[17]. Also, a **lack of financing streams** (McKinsey, 2022), securing adequate funding for large-scale projects and initiatives can be challenging, particularly for cities with limited financial resources (Tiwari, et al., 2021). Moreover, **market structures, behaviours and dynamics**[18] can create barriers to the widespread adoption of low-carbon solutions. For instance, **market inertia on fossil fuel subsidies, inadequate carbon pricing mechanisms, or the absence of supportive regulations** can hinder the competitiveness of clean energy technologies and discourage their adoption (Reckien et al., 2023). Securing adequate funding for infrastructure investments, technology upgrades, and capacity building can be difficult for local governments, especially those with limited financial capacity and competing budgetary demands.

[17] https://www.irena.org/Digital-Report/World-Energy-Transitions-Outlook-2022

[18] https://assets.worldbenchmarkingalliance.org/app/uploads/2020/09/WBA-sevensystemstransformations-report.pdf

3.4 Socio-behavioural barriers

As for the social barriers to the carbon-neutral city concept, usually are related to the lack of involvement and **commitment of society to the reduction of consumption behaviour or change in habits (diet, mobility,'etc)**. Citizens' a'd stakeholders' **psychological resistance to change** is also a common barrier for cities to face when implementing climate actions at a local level. Strategies to tackle behavioural change are indeed at the core of the literature exploring community, and socio-behavioural gaps to enable urban sustainability transformations (Vanhuyse et al., 2023). This is true not only in engaging target groups in emission reduction but also in committing to long-term processes and raising resilience as a set of adaptive and transformative capacities.

These social barriers can influence behaviours, attitudes, and perceptions, ultimately impacting the successful implementation of emission reduction initiatives. Some key social barriers to carbon-neutral cities are overall related to a **lack of awareness**: an inappropriate understanding of climate change and the importance of carbon neutrality can hinder progress (European Commission, 2020). Again, **resistance to change:** people are inherently resistant to change, especially when it requires altering established habits and lifestyles without having immediate, tangible, individual benefits. **Inadequate access to sustainable infrastructure,** such as public transportation, cycling lanes, or renewable energy options, can act as a barrier (Houvila, et al., 2022). Lack of accessibility to these alternatives can make it harder for individuals to adopt low-carbon practices.

These identified institutional barriers impede the much-needed transition toward a more just and resilient carbon-neutral city model. All of them are interlinked, meaning that it is paramount to work across them all to unlock the potential for implementing urban transformations. The usefulness of exploring these barriers stands in the possibility of framing the benchmarking system around those cities' challenges, and thus pushing benchmarking users toward confrontation against these barriers, finding solutions to address and overcome them.

4 The UP2030 Benchmarking

The UP2030 benchmarking system has been defined based on the state-of-the-art about existing frameworks and governance gaps, previously introduced, and the UP2030 planning cycle. In the following subsections, the different steps of the benchmarking structure are introduced.

4.1 Introduction of the benchmarking system

As already explained in the introduction of this report, the benchmarking system is composed of three steps, built on the different milestones in the project timeline.

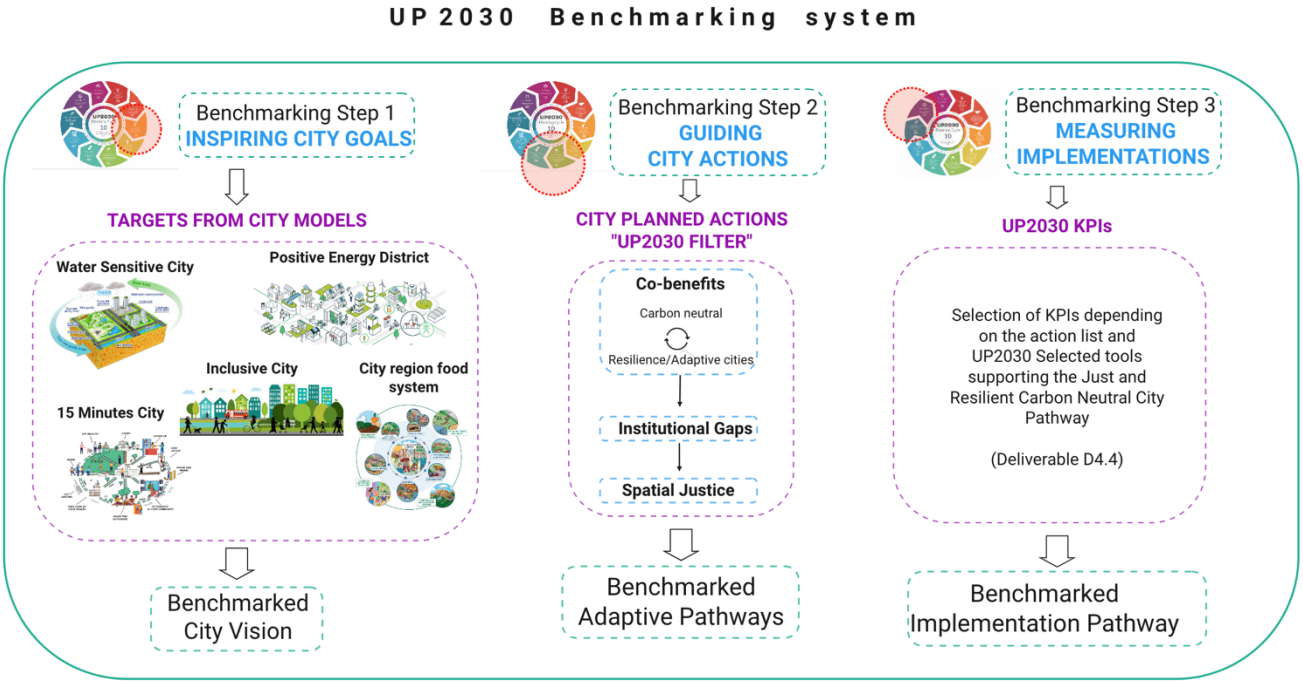

Figure 6: UP2030 Benchmarking system

The articulation of the benchmarking steps with the 10 phases of the Planning Cycle is summarized below:

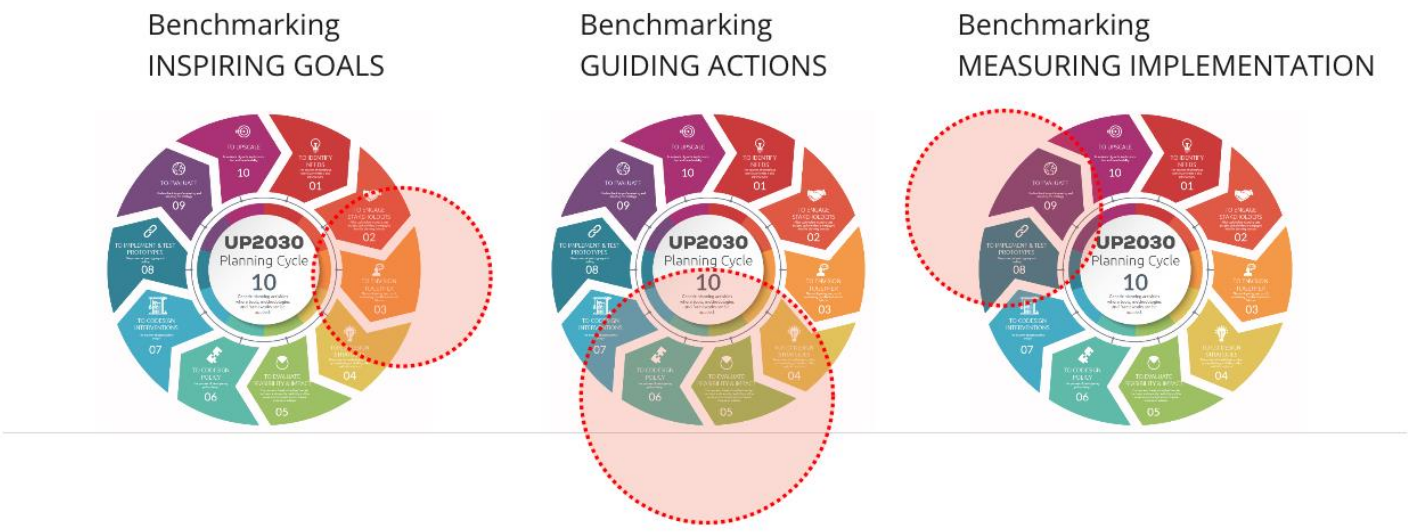

Figure 7: UP2030 Planning Cycle

As illustrated by figure 7, 10 steps constitute the UP2030 Planning Cycle. The first phase, "To identify needs" took place with city pilots right at the beginning of the project. The second ("To engage stakeholders"), and third ("To envision together") correspond to the first step of the benchmarking. Indeed, they aim at stimulating and inspiring the design of policies. The following phases coincide with the second part of the benchmarking, as they focus on the implementation of actions: "To co-design strategies" (phase 4), "To evaluate feasibility and impact" (phase 5), "To codesign policy" (phase 6), "To codesign interventions" (phase 7). Finally, phase 8 and 9, "To implement & test prototypes" and "To evaluate" match with the last part of the benchmarking with focus on defining KPIs to measure the implementation of actions. Finally, "To upscale" is the last phase of the cycle, implying to analyse the needs and following the rest of the cycle once again.

Therefore, the different steps of the benchmarking have been elaborated considering this planning cycle. Depending on their position within the planning cycle, cities can start at different steps of the benchmarking. For instance, it would be useful for a city without any climate or resilience plan should start to identify its needs and visioning solution, thus using the first step of the benchmarking. Another city, in the phase of co-designing policies, would use the second step of the benchmarking. The links between the benchmarking structure and the planning cycle are more thoroughly developed below.

This process is meant to be duplicable and can be applied to all European cities, outside of the 11 city pilots' part of the project. It can be used for all types of scales (streets, neighbourhoods, cities, metropolitan areas).

This benchmarking is the result of our work, investigating the state-of-the-art on existing frameworks and governance gaps, but also of the help of partners, providing technical inputs or participating in the workshop organized in Barcelona on the 26th and 27th of October 2023.

4.2 First step of the benchmarking system – Inspiring Cities Models

As explained previously, the first step of the benchmarking system aims at inspiring city's goals and visions.

Figure 8: Position of the first benchmarking step on the planning cycle

This first step of the benchmarking corresponds to the following phases of the cycle: 2- "To engage stakeholders" through stakeholders mapping and analysis; 3—"To envision together" thanks to participatory processes to imagine possible futures and possibilities; and 4- "To co-design strategies", which is a step-by-step process, where the beginning can be associated with the first step of the benchmarking.

The "Inspiring" can be perceived as quite an allusive term and concept. However, it is necessary step in the process for cities to formulate what direction they want to take and which goals they want to aim for. Indeed, the different stakeholders working in cities can sometimes struggle in defining and envisioning what they can strive. This can be

due to a lack of awareness about the different possibilities or a lack of method for formulating goals.

Thus, by developing different "City Models" we aim to directly impact this part of the cycle. Indeed, the description of various city models and their list of characteristics can help cities' professionals visualize which type of values and goals they can embed in their vision. This is completed by examples of best practices, to help visualise how theoretical models have been developed in real life.

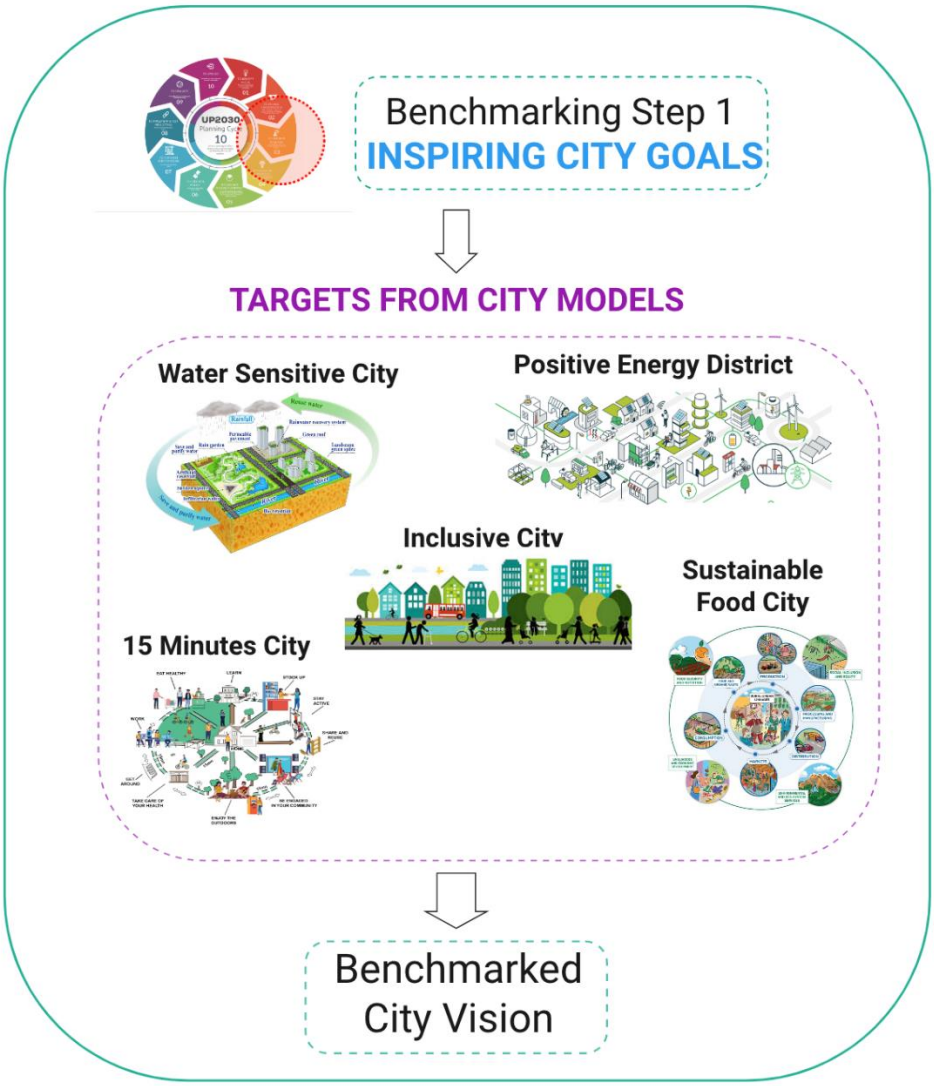

Figure 9: First step of the benchmarking system

Thanks to a literature review and contributions from the technical partners in the project we have been able to get a precise description of five models: the 15 Minutes-City, the Inclusive City, the Water Sensitive City, the Positive Energy Districts (PED), and the Sustainable Food City. These models represent the state of the art synthetizing the main advances of urban planning and design that the cities should aim for.

This benchmarking system works synergistically with the deliverable D2.5 (Report on vision co-design methodology report and its application for pilot shared visions) where a workshop-based method for co-

designing cities' visions, defining cities goals in an integrated way through the participation of the local stakeholders and inhabitants, is explained step by step. Along that process, this benchmarking provides in detail all those different city models characteristics that a city may want to take into account while defining its targets and visions. In order to feed with those models, the process of co-defining cities' visions we provide here a benchmarking system presenting the city models characteristics and principles that could be embedded in other cities visions.

4.2.1 The 15-minutes City

The model of the 15-minutes city revolves around four key principles: Compactness, proximity, diversity and digitalization, as outlined by Carlos Moreno (Moreno et al., 2021).

High density is crucial for the 15-minute city model, as it ensures that a wide range of services, amenities, and jobs are available within a short distance from homes. A densely populated area makes it feasible to have diverse shops, public services, and recreational areas within walking or cycling distance.

Proximity is a cornerstone of the 15-minute city concept. The idea is to design neighbourhoods where residents can access most of their daily needs within a 15-minute walk or bike ride from their homes, reducing the need for car travel and enhancing the quality of urban life.

Diversity is essential for the 15-minute city model to thrive. A diverse urban fabric ensures that residents have access to a range of services, job opportunities, cultural activities, and social interactions within their neighbourhood. This diversity not only fosters a vibrant community but also contributes to the economic and social sustainability of the area.

Finally, digitalization supports the 15-minute city by improving access to services and information. For example, digital platforms can facilitate remote work, reduce the need for physical commuting, and provide real-time information about local services and amenities, further enhancing the convenience of living in a compact, well-planned urban area, but also avoiding unnecessary commuting.

In summary, these four presented principles are integral to the successful implementation and functioning of the 15-minute city model, as they collectively create a sustainable, accessible, and vibrant urban environment. This approach questions traditional and old-fashion land use planning schemes, promoting a shift not only in term of uses mix, but also toward a new standard of urban living. It focuses on transforming existing infrastructures, services, mobility patterns, and also people behaviours, investing in upgrading the liveability of the neighbourhoods.

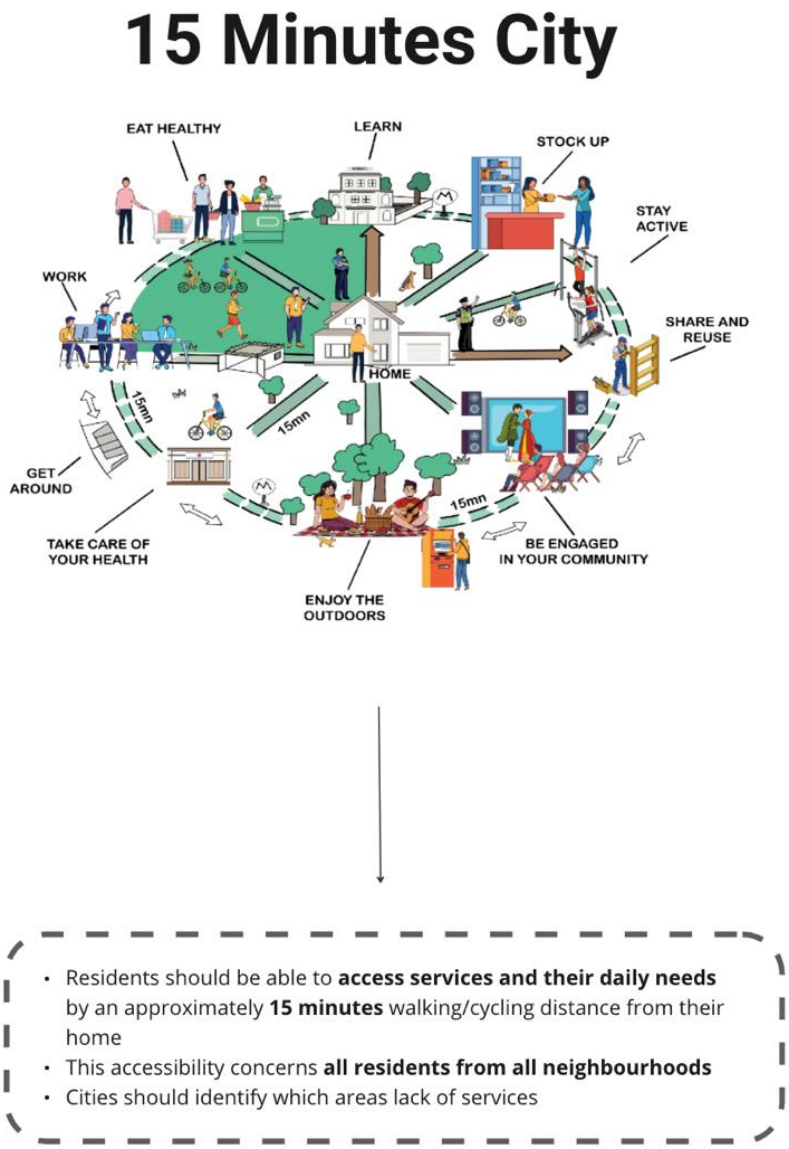

Figure 10: 1– Minutes City - Source: Buro Happold[19]

The example of Barcelona

Barcelona can be seen as a good example of the possible implementation of the model. Implementing the "15-minute city" model in a city like Barcelona, which already has a dense but modular urban fabric, would involve the greening and redesign of the mobility system to guarantee the implementation of the above-mentioned principles.

[19] https://www.burohappold.com/articles/15-minute-cities/

Barcelona is implementing its «Barcelona Green City Plan 2030» (published and adopted 20 years ago already), through what is called Superblock (*Superilles* in Catalan) concept, aiming to drastically reduce traffic while boosting pedestrian areas, and fostering liveable neighbourhoods. This reframing of the mobility is coupled with the enhancement of mixed-use development in both existing and new areas to ensure a harmonious balance of residential, commercial, and cultural spaces (the areas of Eixample, Sant Antoni, and Poblenou for example).

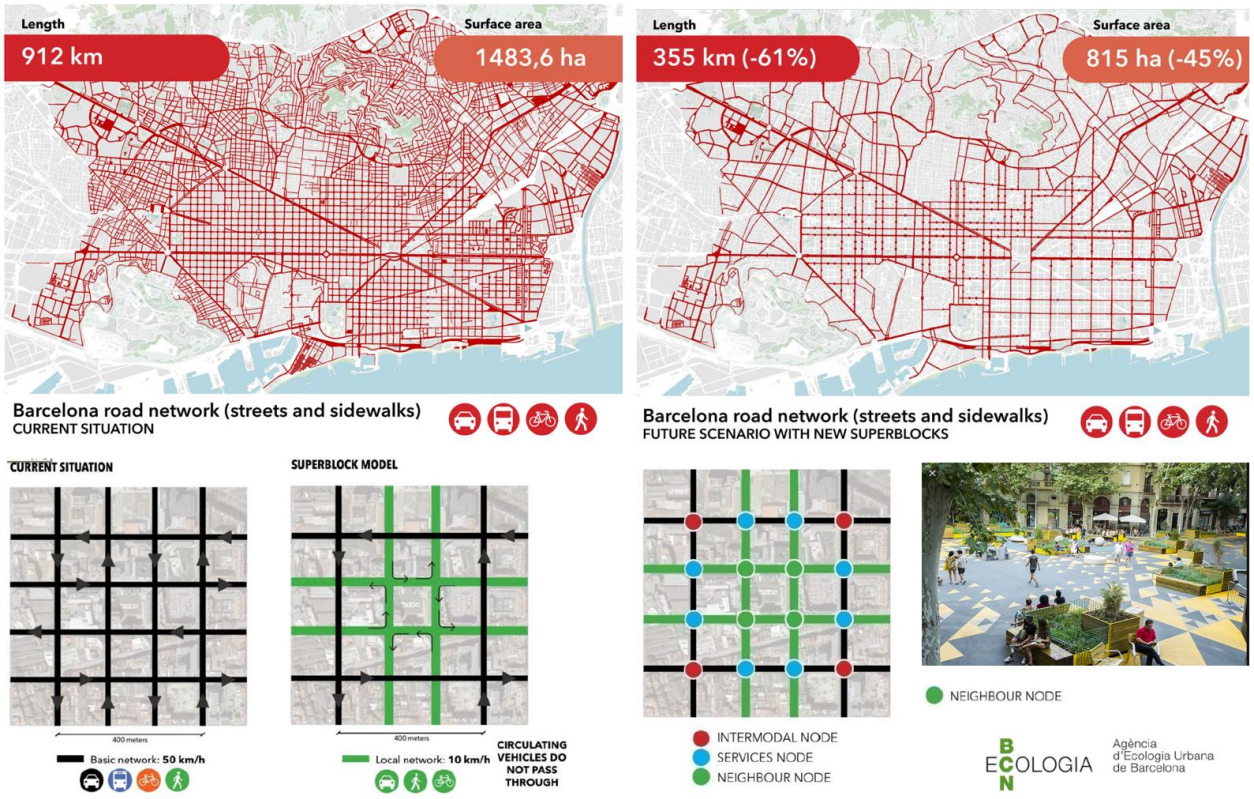

Figure 11: Example of the superblocks in Barcelona. Source: Created by the authors thanks t' the Agencia d'Ecologia Urbana de Barcelona database

As shown in the image above, the core principle of Barcelona green block was a reorganization of the whole street networks, passing from almost 1000Km to less than 355Km. This was possible by reorganizing the city blocks in groups of 9 as shown in the image. The access of cars is blocked of 2 streets every 3, creating the concept of «green block», a unit were cars and buses run around the 9 blocks having mobility intermodal changing points. This almost utopistic urban design is possible on by reshaping entirely the bicycle network and public transport (on which Barcelona has invested since decades).

From the purely greening perspective, Barcelona is notably increasing the number and size of parks and community gardens, primarily in densely populated neighbourhoods (El Clot for example). The city is also utilizing plazas in various parts for community gatherings, markets, and cultural events, contributing to a more vibrant and cohesive urban environment.

Barcelona is also implementing a 15-minute city through actively integrating economic, digital, and environmental strategies into its urban fabric. The city supports local businesses and markets within

neighbourhoods (hundreds of millions of euros were invested in the last decade to refurbish traditional local markets so that every neighbourhood nowadays has a renewed market with local products), reducing travel needs for shopping and services, while also transforming public buildings and historical sites into community and cultural centres. On the digital front, Barcelona incorporates smart city technologies for efficient management of services like waste, energy, and traffic, ensuring digital access for remote work and e-services. In terms of sustainability and resilience, the city promotes the use of renewable energy and sustainable building practices in both new and existing structures, implements city-wide recycling and composting programs, and encourages sustainable transportation methods. Furthermore, Barcelona places a strong emphasis on community engagement, involving diverse groups in urban planning through public consultations and participatory projects, and regularly assesses the impact of these initiatives to refine its strategies. This holistic approach ref'ects Barcelona's commitment to creating a more connected, sustainable, and participatory urban environment.

To conclude, Barcelona website and social media channels could serve as a guiding tool about how to manage a long-term complex transition toward the 15-minute city, that could inspire others about how to practically induce the change and allow people to gradually modify their lifestyles. As a cautionary note respect to this, Barcelona model has been successful respect to urban design, but has a huge social gap: not being able to control market and rental prices. The Municipality, through this transition toward a greener and liveable city, is supporting an uncontrolled gentrification (green gentrification) which, since years, have had a huge negative impact on former residents' lives. Many papers and studies are demonstrating those negative consequences, with old residents being displaced by newcomers and digital nomads, and rental prices doubling in few years. Therefore, herewith a big cautionary note should be posted. The 15min city guidelines are great for improving city built environment, mobility, and quality of life, but municipalities should carefully ask themselves whether they are able to avoid social expulsion and gentrification before developing this model.

4.2.2 The Inclusive City

Figure 12: Inclusive City characteristics. Source picture: The Smart City Journal

The evolution of “he concept of "i”clusive cities" has been a dynamic process influenced by the insights of prominent scholars and international institutions committed to fostering equitable urban development. One of the early trailblazers was Jane Jacobs, whos“ seminal work "The Death and Life of Great ”merican Cities" (1961) laid the groundwork for understanding the significance of community involvement, diverse urban spaces, and resident participation in shaping neighbourhoods.

In the early 1970s, the work of Manuel Castells contributed significantly to the understanding of social dynamics within urban areas, exploring the impact of globalisation and information technologies on inclusivity. This period marked a growing recognition of the global interconnectedness of cities and the need for inclusive policies on an international scale.

Also, in the 70s, the concept of “the right to the city” was articulated by French philosopher Henri Lefebvre, emphasising the idea that urban spaces should be accessible and democratic, ensuring that all residents have the right to pe and use the city according to their needs and desires.

As cities became more interconnected in the era of globalisation, social justice issues expanded globally. Urbanisation in the Global South faced challenges of informal settlements, unequal access to resources, and inadequate infrastructure. Scholars like David“Harvey (e.g., "The Condition of”Postmodernity," 1989) critiqued neoliberal urban policies that exacerbated social inequaliti[es]. The late 20th century also saw the emergence of the environmental justice movement, addressing the unequal distribution of environmental burdens in urban areas. Activists highlighted how marginalised communities often faced disproportionate exposure to pollution and lacked access to green spaces.

As the effects of global networks of capital accelerated, international institutions like the World Bank started recognising the importance of inclusive urban development as a key driver for sustainable economic growth. In 2002, Richard Florida introduced the “oncept of the ”crea“ive class" in "The Rise of the ”reative Class," emphasising the role of diversity in driving economic development and innovation within cities.

In 2010, Susan Fainstein urged for a more just and inclusive urban planni“g approach in ”The Just City," highlighting the importance of social justice in the development of cities. Alluding to the work of Jane Jacobs, Sharon Zukin contributed significantly w“th works like "Naked City: The Death and Life of Authent”c Urban Places" (2010), delving into the impact of urban development on local communities. In 2012, David Harvey furthered th“ discourse in”"Rebel Cities," critiquing neoliberal urban policies and advocating for the right to the city.

Simultaneously, ethical considerations of urban planning were explored by Rich“rd Sennett in "Building and Dwelling: Ethi”s for the City" (2018), contributing to the conversation on the values that should underpin inclusive urban development.

As the dialogue between scholars and international institutions evolved, the United Nations played a pivotal role. Around 2010, the UN began incorporating inclusive urbanisation as a core element of its sustainable development agenda, recognising cities as key actors in achieving global development objectives. The United Nations SDGs, particu“arly Goal 11 ("Sustainable Cities ”nd Communities"), underscore the importance of creating inclusive, safe, resilient, and sustainable cities. This marked a significant shift towards recognising the interconnectedness of cities on a global scale and the importance of inclusive policies in fostering sustainable urban development. The contemporary discourse surrounding the Inclusive City is notably centred on optimizing the coordination and participation of diverse local stakeholders. This approach emphasizes affording each stakeholder the opportunity to contribute to decision-making processes that reflect their perspectives. As elucidated in the paper (Li et al., 2021), a conceptual framework summarises this paradigm’s dimensions. The framework underscores the imperative of creating an inclusive city by fostering an environment that guarantees equitable access to opportunities, services, and resources for all residents, irrespective of their backgrounds. The multifaceted nature of inclusivity within an urban context is underscored, encompassing dimensions that span the social, economic, political, environmental and spatial realms.

The five dimensions are further explained. According to Li et al. (2021):

- **Spatial inclusion** “enables everyone to have equal access to public housing, transportation, and public infrastructure;”
- **Social inclusion** “covers two sub-dimensions: sustainable migration and smart participation and citizenship, and is manifested in people pursuing better living conditions, using their legal entitlements and participating in social activities;”
- **Economic inclusion** “covers two subdimensions: community and finance and segregation and economic regeneration, and is considered as a process of eliminating material inequities and increasing access to employment opportunity;”
- **Environmental inclusion** “requires that contemporary human beings do not carry out their mode of production and consumption in such a manner that the needs and interests of future generations are sacrificed”;
- **Political inclusion** “refers to the relationship between citizens and their (national, regional or local) state in terms of equal political rights and obligations

The example of the OASIS Schoolyard project

Led by the City of Paris, co-funded by the European Regional Development Fund – Urban Innovative Actions (Contribution from Design-CLIPS).

Nowadays, cities usually neglect children and youth by excluding them and exposing them to social, economic, and environmental risks that intensify their sense of being marginalized, which is contrary to the national youth legislation and the idea of 'Just Transition'. One aim of the OASIS schoolyard project is to reintroduce children's wellbeing in urban planning practices.

The OASIS Schoolyards concept was initially formed around the idea of re-naturing existing urban spaces to become more adaptive to climate change impacts. However, it was developed to become an innovative project responding to both social and environmental pressing challenges. The project's overall vision is to create green, accessible, and inclusive schoolyards that function as "cool islands" in the heart of densely built neighbourhoods. A primary design goal of the OASIS approach is to dedicate 20-30% of the total surface area to green spaces, providing a more permeable and natural schoolyard environment. The children's wellbeing, the neighbourhood's social cohesion and the community's active participation throughout the project's entire cycle lie at the heart of the OASIS Schoolyards project.

Figure 13: Picture of one of the OASIS schoolyards in Paris . Source: AIPH

In a nutshell, the acronym "O.A.S.I.S." stands for Openness, Adaptation, Sensitisation, Innovation and Social ties. The project's main activities included participatory processes with the school community, engagement activities with local residents, and awareness-raising workshops about climate change. More specifically, the development of the project relied heavily on (1) the co-designing processes with the school children for re-designing their space and (2) the engagement and participatory activities with the broader school community for sharing the responsibility of using and managing the schoolyard. Additionally, the

project provisioned multiple convenings of experts from different sectors to ensure the appropriateness of the final designs from environmental, social, and educational perspectives.

The OASIS Schoolyard project evolved beyond the pilot phase as the city managed to institutionalize it and secure funding for its replication in more locations across Paris. Today, more than 100 schoolyards are already transformed following the OASIS approach, while the project's concept has inspired similar projects in other cities worldwide.

4.2.3 The Water Sensitive City

The Water Sensitive City model defines an urban environment in which urban transformation to cope with climate change and water-related disasters (increase of storm events, floods, droughts) is led by the reintegration of the natural hydrological cycle within the urbanized environment. The Water Sensitive Urban Design (WSUD) approach is developed as a framework to harmonize an integrated urban management into urban planning and design processes (Hoban, 2019). The WSUD seeks to minimize the negative impacts of urbanization on natural water systems while maximizing the benefits of water in urban environments. All the elements of the water cycle and their interconnections with urban and ecosystem services are considered to achieve an integrated outcome that sustains a healthy natural environment while addressing societal needs and reducing climate-related risks (Raven et al. 2018).

This approach emphasizes the use of green and blue infrastructures and decentralized systems for rainwater management. Recirculation of water on site (decentralization) is indeed among the main concepts for the development of water-sensitive design measures as elements to reshape open spaces (squares, streets, parks) and buildings. The WSUD overcomes the purely engineering and technical approach to urban water management pursuing urban design targets like liveability, aesthetics, quality of urban spaces, multifunctionality, and acceptability. Conceptualizations and practical measures have been framed and developed in several contexts in the last ten years referring to WSUD key principles: socio-technical approaches, whole water cycle management, context-responsive design, and nature-based solutions (Wong et al. 2020).

In the literature, three key pillars underpin the water-sensitive city: 1. the city as a water supply catchment: availability of a diversity of water sources, supplied by an integrated mix of centralized and decentralized infrastructures; 2. the city as a provider of ecosystem services: green and blue infrastructures (in particular nature-based solutions) for urban design are seen as a way to foster ecosystem services 3. The city as a place for Water-Sensitive Communities: water-sensitive decision making and behaviours through a socio-technical perspective (Wong and Brown 2020, Wong et al. 2020).

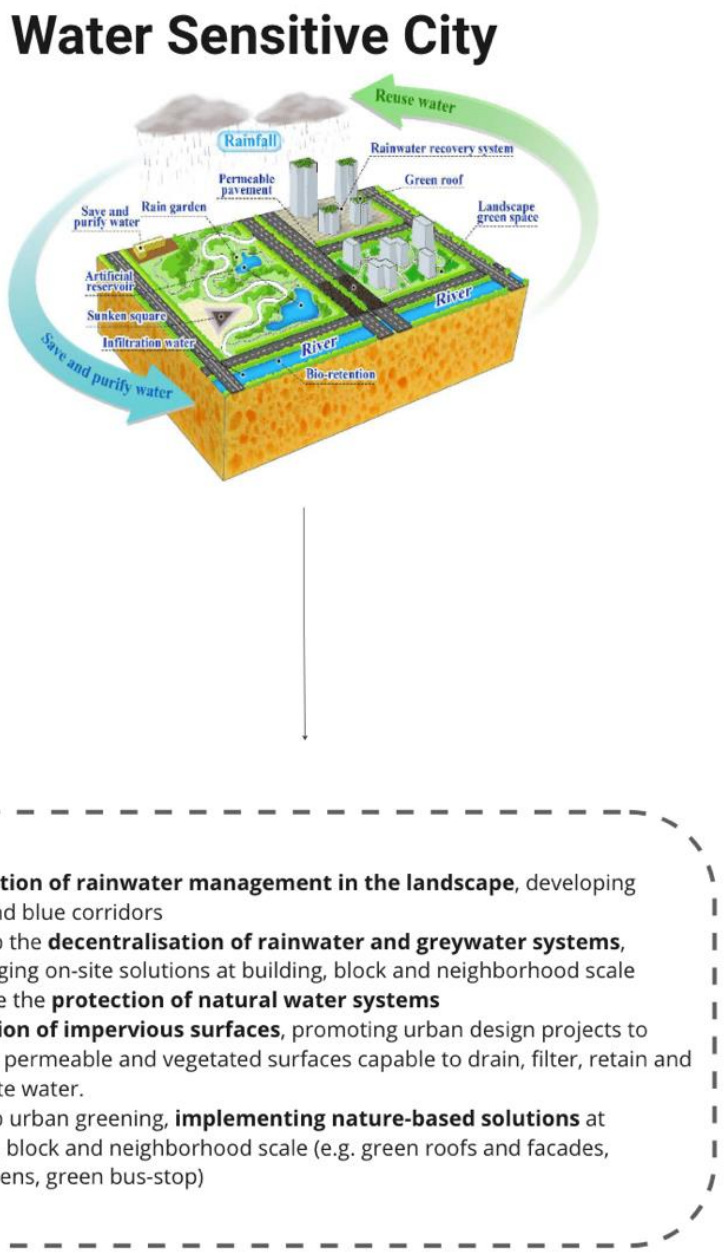

Figure 14: Characteristics of the Water-Sensitive City

The operationalization of WSUD has been carried on by individuating three lines of interventions to reestablish a healthy small water cycle in cities: evaporation measures; infiltration/drainage/retention measures; measure for reuse of rainwater and greywater. This framework aims to introduce a holistic practice into the whole urban water management system and its infrastructures: drinkable water supply, rainwater treatment, waterways, sewage systems, and greywater treatment. These systems are conceived as interdependent to the way the whole city is conceived, planned, and designed facing environmental, social and economic challenges of climate change.

The WSUD is a place-based approach and broader goals need to be tailored on a context-specific basis (Geert et al. 2023, Wong et. 2020). Solutions to facilitate the integration of urban water management in planning and design are developed to respond to specific local needs and characteristics in compliance with specific site conditions, climate data, type of water management already used, community claims and behaviours, financial sustainability, and regulatory frameworks. This indicates that there are no ideal solutions but standard measures that must be developed appropriately and applying a combination of methods, with the aim to integrate technical functionality with land use, urban functions, and infrastructures. The general goals of WSUD that can guide the development of context-specific measures are:

- Integration of rainwater management in the landscape, developing green and blue corridors as amenities and recreational spaces within the urban fabric
- Decentralization of rainwater and greywater systems, encouraging on-site solutions at building, block, and neighbourhood scale, favouring the redundancy of systems
- Protection of natural water systems and increase of biodiversity by fostering nature-based solutions
- Reduction of impervious surfaces, promoting urban design projects to increase permeable and vegetated surfaces capable of draining, filtering, retaining, and evaporating water.
- Urban greening, implementing nature-based solutions at building, block, and neighbourhood scale (e.g., green roofs and facades, raingardens, green bus-stop)

Climate benefits and co-benefits

The major significant benefit of WSUD practice is to consider the integration of water management at different scales from the regional and landscape one to the district, neighbourhood, block, and building ones. This multi-scale aspect translated into design and planning can contribute to create a network of projects and solutions. Thus, the replicability of the single option (for example green roofs or rain gardens) can obtain a benefit on a larger scale (improved urban microclimate, or reduction of flooding), simultaneously promoting a benefit for individuals (reduction of energy consumption to cool buildings and improved quality of life). Moreover, the multifunctionality of WSUD solutions (e.g., coupling of green corridors and bike lines, raingardens, and walkways) allows the development of design solutions that contributes significantly to urban liveability in terms of health, social interaction, and biodiversity. Climate benefits are dependent on the specific solutions, and they range from evaporative cooling effects through vegetation and shade, to the reduction of the amount of water flowing into sewage systems, mitigation of temperature extremes, provision of thermal insulation, provision of ecosystem services like water purification or carbon sequestration (see Table 2. Solutions/Climate Benefits and Co-benefits- Ecological, Social, Economic). From the evaluation of existent samples of WSUD cities main benefits reported are: increase in thermal comfort, resource conservation, disaster reduction, and cost saving, (short term, e.g. reduction of energy to cool buildings, long term e.g. reduction of post-disaster interventions), reconnection between nature and communities.

Table 1: Specific benefits and targets of WSUD

SPECIFIC BENEFITS	TARGETS
Reduce Stormwater Runoff	Target a specific percentage reduction in stormwater runoff volumes
Water Quality Improvement	Achieve a certain level of pollutant reduction (e.g., 30% reduction in sediment load).
Water Use Efficiency	Set a goal for percentage reduction in potable water use through WSUD measures.
Urban Heat Island Mitigation	Establish a target temperature reduction in key urban areas.
Economic Viability	Aim for a positive return on investment within a specified timeframe.
Community Engagement	Engage a specific percentage of the community in WSUD-related activities.

The WSUD approach has been developed in several cities in Europe, North America, New Zealand, Australia, and developing countries. Cities at the forefront of water-sensitive initiatives are Copenhagen, Sydney, and Melbourne, where dedicated protocols, design guidelines, urban codes, planning frameworks and policies have helped to implement the approach in a multi-scale perspective, widespread across building and urban projects to achieve multiple goals for the regeneration of the urban fabric in terms of risk reduction and enhancement of environmental quality and microclimate conditions (Kazmierczak and Carter, 2010). In terms of carbon neutrality, recent studies are bringing insights into the potential of carbon sequestration from WSUD measures (Kavehei et al. 2018), while their effective coupling with carbon-neutral mobility networks (e.g., bike lanes, tramways, pedestrian areas) can contribute to increase the carbon reduction from the transport sector. The approach has strong social components as participatory design and community engagement are key principles, although spatial justice implications have been less explored. While in global North samples, WSUD resulted in dynamics of green gentrification, in some cases in Global South the approach has been used to deliver spatial justice outcomes (e.g., Lima, LIWA project) (Eisenberg et al. 2013).

Example of good practices – the findings in London and Copenhagen

Table 2: Summary of the findings for green/ blue city model

Case Study City	Summary of Blue-Green Interventions per Case Study	Broader Interventions
London	- Extensive parks and green spaces - London Green Grids project & Low Emission Zoning - London's Trees and Woodland Framework to increase tree coverage - London Environment Strategy, which sets goals for reducing carbon emissions, improving air quality, and increasing recycling rates	- Accessible, extensive green spaces - Increase tree coverage - Standards and regulations to reduce carbon emissions and improve green infrastructure
Copenhagen	- Bicycle lanes, dedicated cycling bridges, and bike-sharing programs - Numerous parks and green spaces for reduced carbon emissions - Canals manage stormwater runoff and enhance urban water quality - Renewable electricity generation - Green roof implementation	- Accessible, integrated bikeways - Accessible, extensive green spaces - Stormwater runoff management - Green roofs

4.2.4 Positive Energy District (PED)

The concept of PED was defined under the framework of EU's SET Plan Action Nº 3.2 as follows:

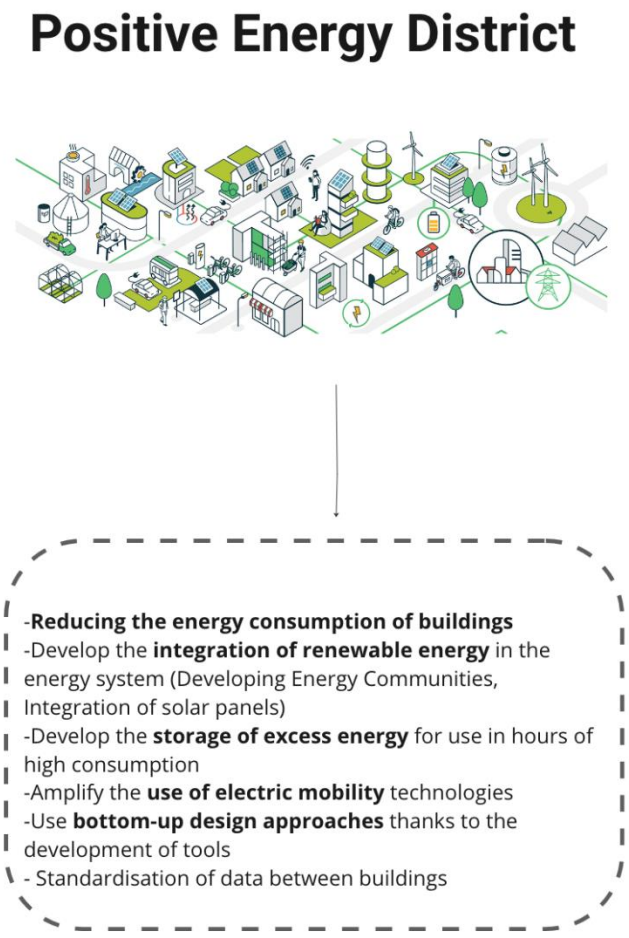

Figure 15: Characteristic of the PED. Source picture: DUT Partnership

"Positive Energy Districts are energy-efficient and energy-flexible urban areas or groups of connected buildings which **produce net zero greenhouse gas emissions** and actively manage an **annual local or regional surplus production of renewable energy**. They require integration of different systems and infrastructures, and interaction between buildings, the users and the regional energy, mobility, and ICT systems while securing the energy supply and a good life for all in line with social, economic, and environmental sustainability".

On the other hand, the EU's goal of reducing emissions by 55% by 2030 and achieving climate neutrality by 2050 would not be possible without optimizing the energy balance of cities. Given that 75% of Europe's population resides in cities and the increasing emphasis on retrofitting existing structures to accomplish complete decarbonization by the year 2050, there is both a significant chance and a pressing necessity to target innovative strategies at the community and residential level, rather than focusing on individual buildings. However, the optimal energy balance as well as the reduction of emissions in systems as complex as a whole city represents a technical challenge at present. Therefore, the segmentation of cities into districts has allowed progress in this issue while other aspects related to context, incentives, social, regulation, and market readiness are still evolving.

According to the above, a PED consists of the geographical segmentation of a city in which the emissions associated with energy consumption are zero and there is an excess of renewable energy production to interact with other PEDs in a period (annual energy balance is the most accepted one for calculating the energy balance). However, this assumption is not sustainable unless all possible interactions of the energy systems are considered. As an example, the integration of renewable energy sources entails an increase in emissions due to the manufacture, installation, and transport of these equipment. In addition, the economic assumption is another factor to evaluate.

Therefore, achieving a PED involves reducing the energy demand of buildings, integrating renewable energies, storing excess energy produced for use in hours of high consumption, and managing electric mobility as consumers, and as a means of storage, if possible, among others.

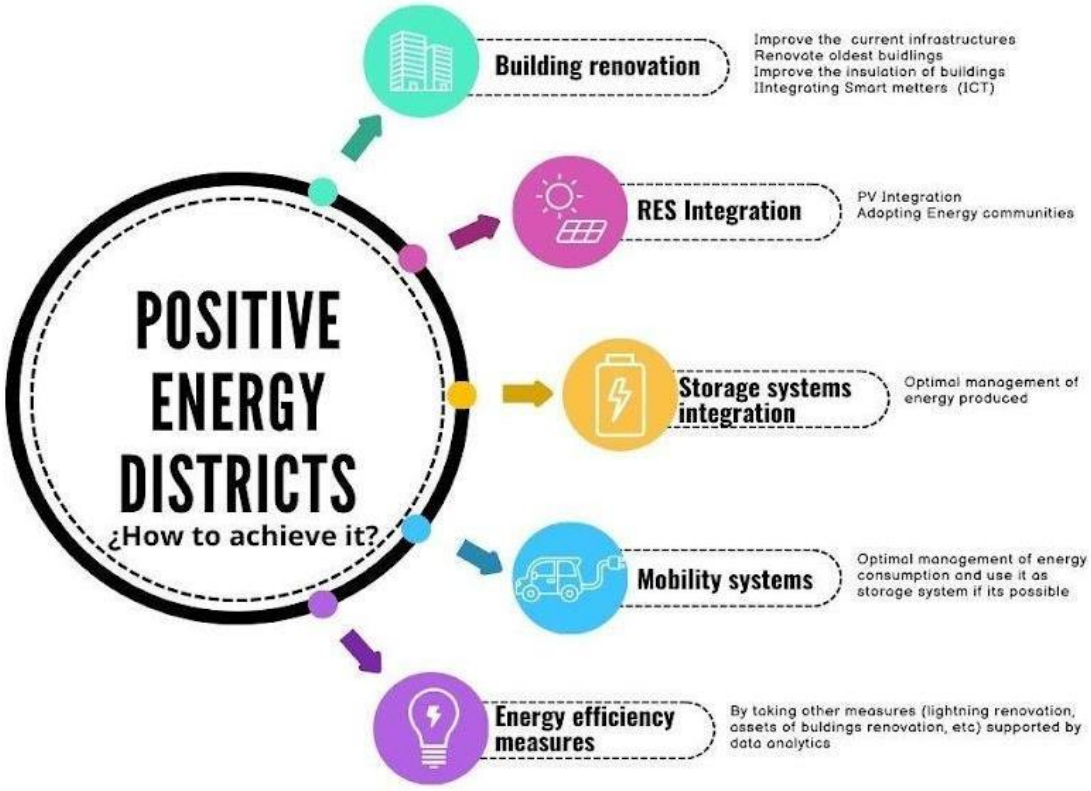

Figure 16: How to achieve Positive Energy Districts?

In conclusion, a PED not only involves energy generation and consumption but also the emissions associated with all systems, equipment, infrastructures, etc. Future efforts for PEDs include the integration of full life cycle assessment, development of mobility technologies to manage electricity consumption development of tools for bottom-up design approach, development of digital models to obtain data and extract value from these data to support the decision-making process, standardization of data between buildings and in the other hand to use energy baseline knowledge to participate in flexibility programs or demand response by aggregation, etc.

The concept of PED is relatively new and is something that is still under construction, therefore different European projects have been carried out following different methodologies and each one has its own particularities, so replicability is a complex process.

The example of Zaragoza

The CIRCE research and implementation centre is working on the implementation of the Positive and Clean Energy District in Zaragoza in the NEUTRALPATH project (Horizon Mission Cities project). Zaragoza has

selected a representative area of the city composed of 6 buildings, 2 public housing located in the Actur-Rey Fernando district (2 social housing), and other 4 public buildings located in the same neighbourhood: a public elementary school (built in 2008) and a public school (consisting of 3 buildings built in 2007) that are owned by the City Council of Zaragoza. Although this PED design and implementation is ongoing, here are some of the interIns which include several interventions.

First, developing retrofitting has been identified as one of the main methods to reduce the energy demand. To do so, three main measures have been implemented: (i) the rehabilitation of façades to enhance the insulation of the buildings using recycled polyurethane foam granules, (ii) the replacement of buildings' windows with triple glazing to achieve high-performance coating with higher visible transmission and higher energy efficiency, and (iii) the improvement of window carpentry to prevent energy loss in windows by minimising frontal exposure of the system's features through a concealed sash window with high glazing capacity.

Then, to enhance the efficiency of the heating, ventilation, air conditioning and hot water systems, high-temperature CO2 pumps have been installed in residential buildings, with an installed power of 30 kW to produce 100 % of domestic hot water.

As for the development of an Integrated Renewable Energy Sources, active-ventilated PVfaçades have been equipped, with the aim of an optimal performance and electric energy utilization. Plus, required wells to provide the hydrothermal energy needed by the LowEx have been implemented.

Finally, to encourage E-mobility in the area, V2G 12.5kW chargers for electric or hybrid vehicles have been developed, to enable recharging electricity at the lowest possible price and feeding it to the grid when it is most expensive.

4.2.5 Sustainable Food City

The sustainable food city is a new model pushing for redefining a more sustainable and inclusive food system for cities. The aim is to redefine all the actors, processes and relationships that are involved in food production, processing, distribution, and consumption in a given city region to make it more resilient, sustainable and just.

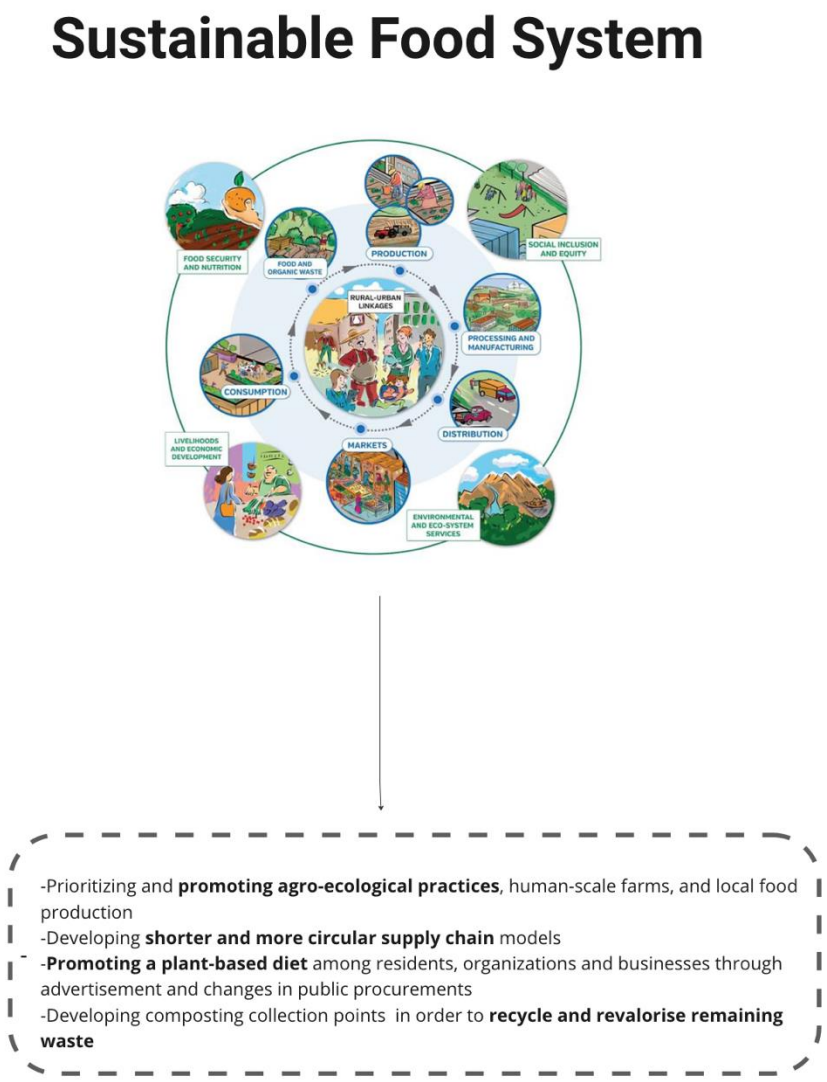

Figure 17: Characteristics of a Sustainable Food City. Source: FAO

Up to 70 percent of the food produced worldwide is consumed in urban areas[20]. Nevertheless, current food systems, predominantly industrial, are harmful for the environment, fragile and unfair (e.g., they are responsible for ⅓ of the total global greenhouse gas emissions, supply chains are mostly long and linear making them unstable and vulnerable, social inequalities are growing among both producers and consumers, etc.). Food systems are central not only when approaching health and food security but also key when addressing biodiversity loss, climate change, resources management and land consumption, economic development, water and waste management, energy, transport, etc. It is therefore essential to address food systems in a systemic way, also from the lens of urban transformation to induce regional changes for climate mitigation and adaptation.

The characteristics of a more sustainable, resilient, and just city region food system should encompass all the stages of the food chain, from production to food waste (as represented on fig. 14). Approaching them one by one helps us to understand the changes needed and to highlight the aspects that municipalities could integrate within their plans.

[20] https://www.fao.org/3/CA3151EN/ca3151en.pdf

The **food production**, despite being mostly far from the municipality leadership, should prioritise agro-ecological practices that preserve resources and biodiversity, abandoning intensive agriculture methods and promoting technical, energy and seeds autonomy. Human-scale farms must be supported to enhance inclusive, collaborative and fair food production, essential to increase the farming population dramatically declining (decreased by 37% between 2005 and 2015[21]). Finally, local food production must be promoted, not only for social and economic reasons but also to guarantee more food security by shortening supply chains and by diversifying the production and the producers with redundancy to reduce the food production's vulnerability to diseases or to environmental crises.

The **processing** phase of a food system must be reduced and simplified in order to decrease its energy consumption, its waste production and its mainly detrimental impact on health. The majority of the food produced does not need to be processed to be consumed. Regarding the **distribution phase**, as mentioned before, the chains must be shortened and more circular to support a more local system and reduce the risks and dependency inherent to long supply chains but also to reduce its carbon emissions. The food distribution must support solidarity, both locally and with inevitably more distant partners. About the **market** stage of the system, it must guarantee a reliable access to healthy food to every socioeconomic group while supporting a fair remuneration of the producers. A project called ***True Cost Accounting*** led by the *Sustainable Food Trust Organisation* is for instance currently testing new ways to adapt the market to its true cost[22] and should inspire new ways to align the food market sector to its system.

One of the main levers of action available to municipalities and policy makers is to act on **food consumption** by promoting plant-based food and food habits changes among not only residents but also enterprises and businesses. The promotion of new consumption habits can be supported by simple policies or actions like banning meat advertisement from the city (like the city of Haarlem in the Netherlands), regulating the food offer in schools, universities and businesses canteens or developing food gardens in schools and public areas (like the Oasis Project in Paris), impacting two generations at once through children and their parents.

Last but not least, **food waste** management must be improved. In 2022, 17% of the food produced worldwide was wasted after its production[23], while in Europe, 7% of the population is considered undernourished by the United Nations. Unsold food must be redistributed, and the remaining wastes must be recycled and revalorised. Soil nutrient depletion is one of the biggest challenges agriculture is currently facing. One of the best and only ways to tackle it is by collecting organic waste and bringing its nutrients back to the soils through natural processes like composting. More and more cities are organising organic waste collection points for citizens and businesses in order to be able to reinject them in crops soils.

Although many aspects of food systems fall outside the scope of municipal authorities, their intervention is essential to activate, support and accelerate the transition of urban food systems towards resilient, sustainable and just systems.

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[21] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Farms_and_farmland_in_the_European_Union_-_statistics

[22] https://sustainablefoodtrust.org/our-work/true-cost-accounting/#implementing-true-cost-accounting

[23] https://www.un.org/en/observances/end-food-waste-day

The examples of Milan and Barcelona

The International Milan Urban Food Policy Pact:

In 2015, more than 100 cities signed an international protocol aiming to tackle food-related issues at the urban level. "**The Milan Urban Food Policy Pact** (MUFPP) gathers cities from all over the world committed to advancing on the common goal of sustainable, inclusive and resilient urban food systems." The pact is not only a source of inspiration but also a concrete working tool accessible to every city, a monitoring framework composed of 37 recommended actions clustered in six categories: governance, sustainable diets and nutrition, social and economic equity, food production, food supply and distribution & food waste. Since its first edition in 2015, the MUFPP has collected 621 practices from 270 countries around the globe[24].

The Milanese Cool Food Pledge Initiative:

In 2022, the city of Milan has been awarded by the MUFPP for its school canteens project "Cool Food Pledge Initiative" in the [Sustainable Diets and Nutrition] category. In less than five years, Milan school canteens have reduced their carbon emissions by 20%[25] thanks to this food policy commitment by promoting plant-based meals and reducing red meat in the 85,000 meals served every day. Only by shifting their menus, Milano Ristorazione is supporting Milan's population's transition to a healthier and more sustainable food consumption and changing its habits and mentality.

Figure 18: Advertisement from the city of Milan.

[24] https://www.milanurbanfoodpolicypact.org/award/

[25] https://foodpolicymilano.org/en/reduced-by-20-the-co2-emissions-of-the-menus-of-the-school-canteens-in-milan/

(image ref.[26])

Example of Slow Food in Barcelona:

Slow Food is a "global movement acting together to ensure good, clean and fair food for all" active throughout the world and acting at all levels of food systems, reaching more than 1 million people in 2023[27]. In the city of Barcelona, the Slow Food Movement is organised as a non-profit association promoting sustainable food, circular economy and creating a bridge between producers and consumers through various initiatives with the municipality support. Since 2015, the Slow Food Market "Mercat de la Terra de les Tres Xemeneies", takes place every Saturday morning in a public space in Poble-Sec, promoting and supporting sustainable and fair food systems. The market quickly became a reference as it gathers and connects every week hundreds of consumers with more than 40 producers from the region, providing the opportunity to exchange high quality sustainable products at a fair price for the customers and the producers with no intermediaries, developing the local circular economy. Last but not least, the market is a food transition hotspot at every level, collecting organic waste and raising awareness by organising talks and workshops, tasting and show cooking, and many more social activities.

Figure 19: Picture from the Slow Food.

(*image ref.[28]*)

[26]https://foodpolicymilano.org/en/reduced-by-20-the-co2-emissions-of-the-menus-of-the-school-canteens-in-milan/

[27] https://www.slowfood.com/

[28] https://slowfood.barcelona/index.php/mercat-de-la-terra

Thanks to the contribution of UP2030 technical partners, this part of the benchmarking framework introduced different city models, highlighting for each one the list of the main characteristics, a longer description, and an example of best practices to allow anybody modify the city vision and targets. The aim of these models is to provide content for policymakers and city professionals at early stages of policymaking, during participatory and visioning processes. If a city has yet to develop a set of climate and resilience-related goals, this step can help stakeholders imagining what could be possible depending on their city context. If it is already done, cities can still use this step to benchmark their vision against the models, in order to improve it. Once this step is done, cities move on in the planning process and therefore will use the second part of the benchmarking, explained in the following section.

4.3 Second step of the benchmarking – The UP2030 Climate Actions Filter

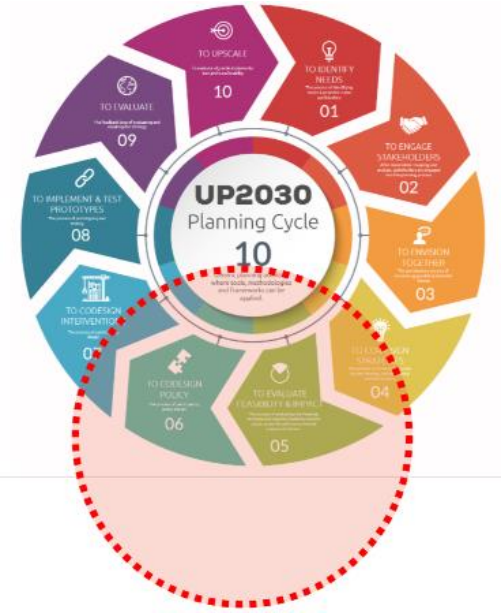

Figure 20: Position of the second benchmarking step on the planning cycle

As introduced previously, this second benchmarking system works to guide and enhance cities actions toward the UP2030 approach of "just and resilient Carbon neutrality" (see deliverable introduction). What do we mean by "city action"? Looking at the UP2030 planning cycle, the phases 4 Co-design strategies, 5 evaluate feasibility and impact, 6 codesigning policies and 7 co-designing interventions are those where cities translate their agenda, visions, ambitions, into plans containing actions. By "actions" we refer thus to any intervention (could be a policy or a project) wishing to implement a climate plan, strategy, agenda.

Most of the cities struggle in implementing their plans and strategies, toward effective, integrated, and consistent projects and policies. Indeed, within implementation phase of any city plan, the challenge of policy coherence and policy consistency are huge, requiring coordination, flexibility, efficiency, multi-stakeholder involvement etc. Therefore, many good strategies, many good plans or city agenda fails in their implementation phase because of poor, partial, fragmented, or limited ability to execute in practice planning guidelines and objectives. Knowing that a good plan for carbon neutrality or resilience struggle in meeting spatial justice or avoiding risks trade-offs, this benchmarking guides - as a "methodological checklist" - how the implementation of any climate plan or city carbon neutral strategy is conceived, making sure there is a consistency and alignment among carbon neutrality, resilience building and spatial justice.

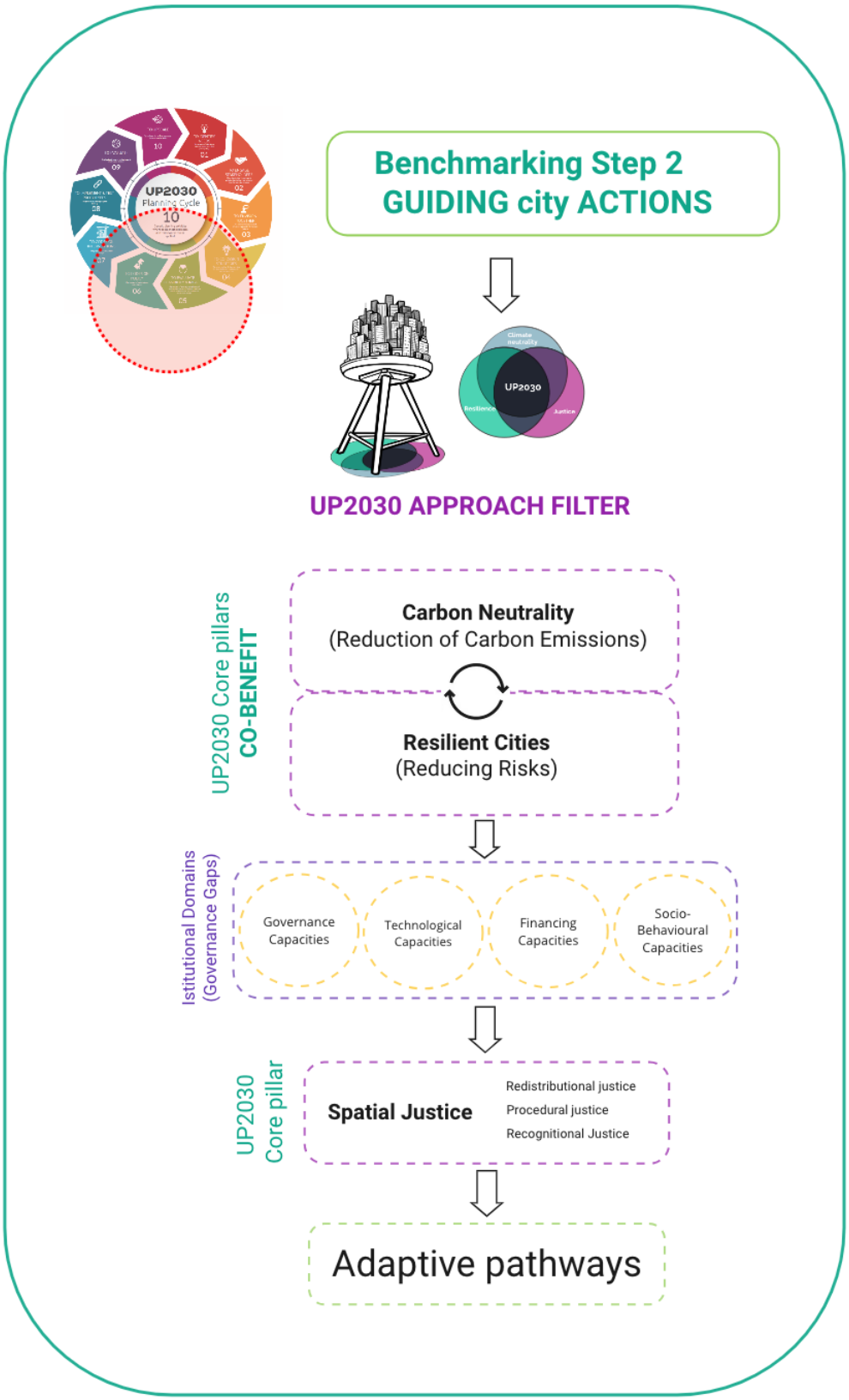

Figure 21: The UP2030 Action Filter

This is done thanks to a step-by-step guide showed in the introduction of the deliverable and reported here too in the following image. Also, as for the first part of the benchmarking, this part too has been developed and is followed by the D2.5 which is providing the guidelines to co-design an adaptive pathway strategy (showing how through a co-design process a city vision is grounded and translated into a set of synergistic actions and potential alternative actions, so to display a roadmap for a consistent implementation of the city vision in actionable projects an steps).

This action filter is structured in 3 main parts:

1. At a first stage cities' climate actions are tested against a set of questions to avoid trade-offs between climate adaptation and mitigations, guiding their definitions toward a co-benefit framing of climate implementation.
2. In a second step, cities' climate actions are tested against a set of questions exploring if the main (identified) barriers to implementation are tackled (thus making sure that all the actions are actually feasible and tacking the right implementation mechanisms.
3. A final part of the benchmarking is asking the actions whether these comply and guarantee spatial justice, or whether these could exacerbate inequality, social unrest, or there are risks' trade-offs embedded.

These three steps represent the core structure of this second benchmarking, guiding cities in the design of their climate resilience implementation roadmap, or, as we call it in the UP2030 project, the adaptive pathways to operationalize cities visions. In these following points the three steps are presented in depth.

UP2030 Core Pillars "Co-benefits Enhancer"

In this part of the benchmarking framework there is a user-friendly graphic which could help cities assessing their climate actions toward a synergistic and co-benefit outcome, avoiding greenwashing or safety-washing.

The simplified outline of this step of the benchmarking is based on the need of being enough generic to allow any city, any size, to assess any climate action (reduction of carbon emission or reduction of risks' exposure or sensitivity) respect to a set of questions which will allow cities to reflect about co-benefits. For each question about a potential trade-off, there is space for thinking of compensation mechanisms, to avoid unintended trade-offs, and maximizing the synergies among climate change adaptation and mitigation actions.

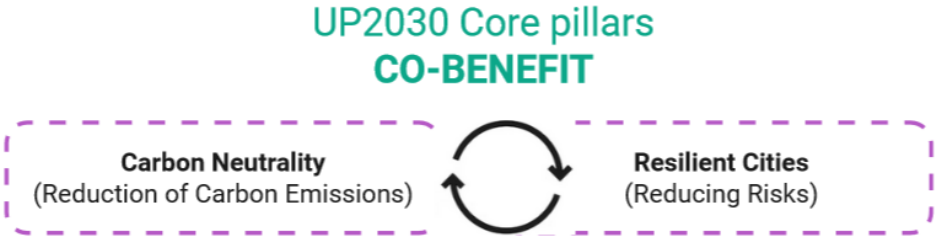

Figure 22: Trade-offs and co-benefits between sustainability and resilience

Table 3: Questions for the first part of the Action filter

Action potential trade-offs	Compensation mechanism
Is your action (i.e. cleaning solar panels) increasing the use of water in a scarce water country?	
Is your action increasing urban densification for energy optimization increasing soil sealing? Is you action increasing urban densification for energy optimization decreasing green spaces?	
Is your action of planting trees decreasing biodiversity, or increasing the use of water? Is your action of Carbon Capture and Storage (CCS) decreasing the resilience of some local ecosystem?	
Is your action of reducing fossil-fuel mobility increasing the use of fossil fuel vehicles outside the city boundaries or in other places as a consequence?	
Is your adaptation measure increasing non-renewable energy consumption? (i.e. air conditioning, pumping water, any engine use?)	
Is your adaptation measure increasing water consumption?	
Is your adaptation measure increasing the carbon footprint? (i.e. one time building -embedded carbon- structures or infrastructures)	
Is your adaptation measure relying on technology and thus decreasing the potential of using green infrastructures or reducing biodiversity?	

As per the previous steps in the first part of the benchmarking, this exercise of guiding climate actions toward co-benefits is intended also to follow the process of co-designing adaptation pathways, as explained in the deliverable D2.5.

This first part of filter is followed by a second one, where the actions are benchmarked respect to their feasibility, coherence and socio-economic sustainability.

The institutional domains of actions – the "overcoming urban transformation barriers" step

As the name of this part refers to, herewith the city actions are guided through a list of questions to check if and how far these are taken into account across different institutional domains of action (defined in the second section of the deliverable, where we explored current urban transformations' gaps from the literature). These domains of action are illustrated in the figure below and the assessment works again as

the previous step: each climate action needs to go through all these 4 governance domains aspects, to see whether it could be reshaped and enhanced. The potential enhancement comes from check each action relation to the potential governance, technological, financial, and socio-behavioural capacities, and think of how potential barriers in each domain could be overcome by re-shaping or enhancing the climate action (with other complementary actions, ensuring its feasibility, consistent implementation, and sustainability).

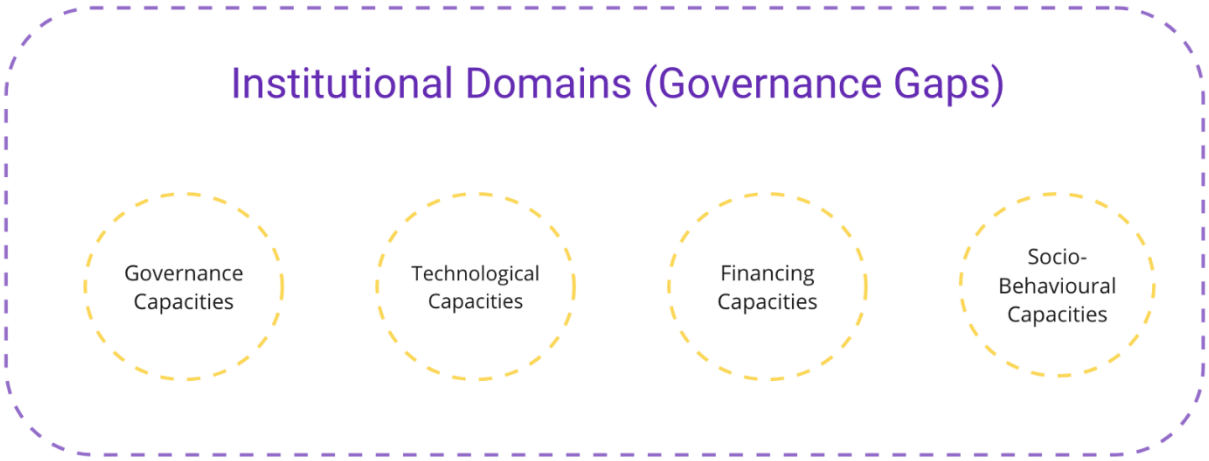

Figure 23: The main governance gaps

Table 4: Questions for the second part of the Action filter

Governance gaps	Follow-up question
Governance Capacities	Is your action enhancing multiscale coordination to improve multilevel governance? Is your action considering the inter-dependencies among different institutions departments and enhancing coordination? Is your action supporting transformative governances or maintaining status quo - business continuity? Is your action contributing to cities' practitioners learning and improvement of knowledge and skills?
Technological Capacities	Is your specific technological action up-scalable without needing mayor infrastructural retrofitting? Is your technological action based on outsourced capacities and management, or it could be managed locally?

	Is your action supporting a decentralization or distribution of infrastructures and services so to enable a societal learning and transformation?
Financing Capacities	Is your action supported by a sustainable business model ensuring financial streams? Does your action need high up-front costs? If yes, how you would replicate it? Are there any subsidies or policies supporting the inertia of fossil fuel solutions and thus impeding your action? Is your action creating new business opportunities for local stakeholders or involving them?
Socio-behavioural Capacities	Is the community (or part of it) actively included in the transformation process lead by your action? Is your action supported by some educational (capacity building) programs to support behavioural changes? Is part of the community receiving support and funding to lead actions toward UP2030 approach? Is community embedded within a continuous participatory process to co-design, co-manage urban transformation?

Ensuring Spatial Justice: How to align climate action with spatial justice

Last but not least, this part of the framework wishes to seriously guarantee that justice is embedded within resilience and carbon neutrality. The EU introduced the European Green Deal, aiming at a Just Transition where citizens are equipped to address the social and economic impacts of the transition towards a climate-neutral economy. In order to do so, a consistent reformulation of current planning and management principles is needed, enhancing the redistribution of wealth and rights. As largely introduced in the previous sections, within this project the concept of justice is understood in a practical way and related to urban planning and management. Therefore, the term of "Spatial Justice" is the most appropriate way to address it. There is still no consistent agreement of the definition of spatial justice (Brown et al., 2020). The Technological University of Delft (TUD) recently, in December 2023, organized a symposium on benchmarking spatial justice to further explore how to address this research challenge. From this recent international event and the Benchmarking workshop held in Barcelona in October 2023, we defined some category of questions which, despite partially overlapping, are tackling the different aspects of spatial justice: recognitional, redistributional and procedural justice.

In the image below, some questions have been prepared to guide the assessment of city action and guarantee that inclusivity, empowerment, transparency, and other principles are embedded within the implementation of the action. Indeed, a crucial factor is to be considered when addressing social justice: it is not about a specific climate action which *per se* could imply climate injustices (i.e., green roofs, shift to electric vehicles) but about ***how*** projects and policies are implemented (i.e., decision of funding green roofs only in specific parts of the city, target beneficiaries without considering the most vulnerable

population, incentives for renewables more likely to be accessible to highly-skilled citizens due to complex administrative processes, etc.).

In light of these specific unwanted and unjust outcomes of climate actions, the list of question of this part of the framework wishes to assess the final actions (after all the previous filters' steps) and refine them, in order to avoid green-washing or safety-washing in this phase of policy or project design.

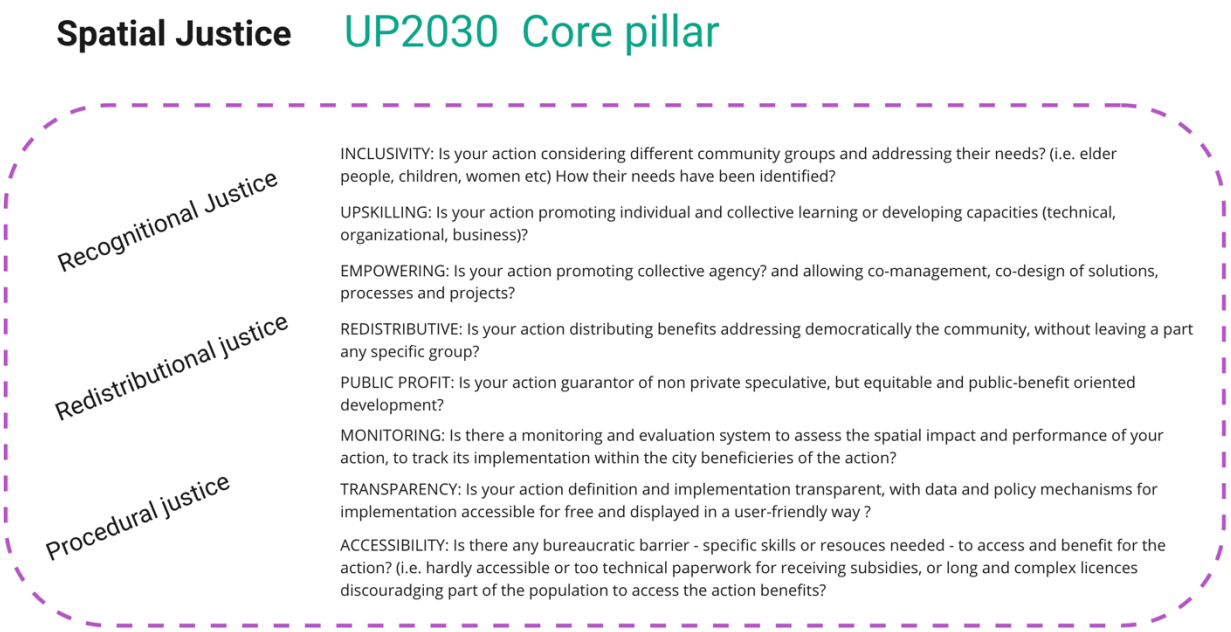

Figure 24: Questions for the third part of the Action Filter

Although recognitional, redistributional, and procedural justice are overlapping concepts, the guiding questions for the municipalities, which serves as a last filter for cities' actions, encompass specific questions which are not exhaustive, unfortunately, but only exemplificative. Ensuring transparency across processes, accountability, monitoring, and evaluation of policies are practices that should already be implemented but unfortunately, a lot of work is still needed in many European municipalities. These few questions should be able to introduce a critical thinking that a comprehensive benchmarking system for spatial justice will complete and will be available on the project website before the end of the UP2030 project.

Unfortunately, an integrated and exhaustive benchmarking system is still under discussion. However, many specific guidelines fighting gentrification are available and broadening their dissemination and impact across social movements and academia (cf. URBANA project with their 50 tools to fight green gentrification for example). This last part of the benchmarking framework can also introduce these at an institutional level, while the project develops the full benchmarking on spatial justice.

4.4 Third step of the benchmarking – The UP2030 Solutions KPI's

Figure 25: Position of the third benchmarking step on the planning cycle

As previously explained, the last part of the benchmarking system aims at measuring the implementation of the climate actions previously defined, in the earlier stages of planning cycle.

This step of the benchmarking corresponds to the following phases of the cycle: 8 – "To implement and test prototypes" and 9 – "To evaluate". This last step allows to propose changes and adapt the implementation strategy, if needed. This evaluation can also lead to the decision to upscale the action (Step 10 of the cycle). In that case, the identification of the city's needs for upscaling would be necessary, and the planning cycle would start again from Step 1.

This "measuring" step intervenes later in the process and aims to verify the great implementation of the actions defined and refined thanks to the Climate Actions Filter. In order to do so, a list of KPIs needs to be selected for each city, according to their list of actions and selected tools. This step of the benchmarking will be detailed in the Deliverable D4.4 "*Report on monitoring, evaluation and KPI validation in the 5UP-approach implementation pilot 1*" drafted by the Universitat Politecnica de Valencia (UPV) and further developed in the next year of the project.

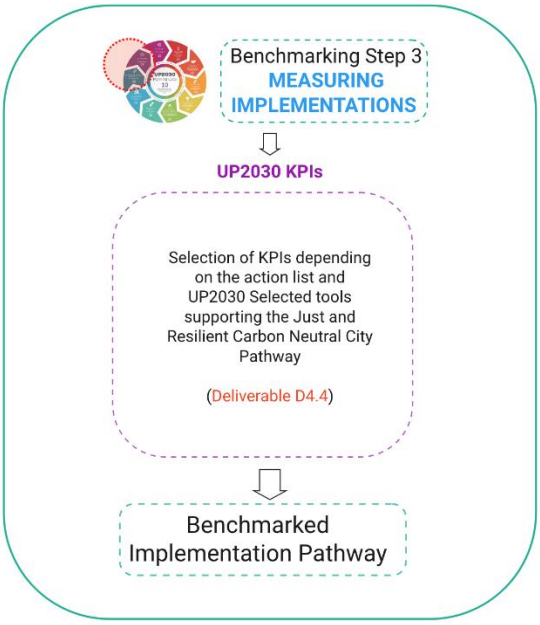

Figure 26: Third step of the UP2030 benchmarking system

Several principles need to be followed to establish a coherent list of KPIs. Indeed, defining a comprehensive list of KPIs means considering the complexity and wide variety of policies that can be implemented by municipalities. To do so, the UPV team should refer to the state-of-the-art on different urban topics (Section 2.2). As this part addresses the topics of expertise of several UP2030 partners, they can be easily approached in order to help define precise indicators on each of their topics.

The UIC team could also help in providing these, as the definition of KPIs has been part of the brainstorming prior to the Workshop held in Barcelona in October. Once a comprehensive list of KPI is established, the second step would be to choose a list of KPIs adapted to each cities' context. The choice of indicators should be directly related to cities' visions (defined in the first step of the benchmarking) and the actions defined through the filter. Overall, the KPIs should address: (i) specific indicators about each climate actions (targets about the implementation process and specific goals), and (ii) specific indicators related to institutional gaps and spatial justice to ensure that these two domains are considered during implementation.

5 Conclusion

This deliverable started by analysing the existing benchmarking frameworks and by doing a state-of-the-art on specific urban topics and governance gaps. From this, the following conclusions have been deduced.

The analysis of the state-of-the-art on existing benchmarking frameworks allowed us to see the level of integration of the three pillars: resilience, carbon neutrality and spatial justice. The results showed that there is a stronger presence of resilience assessment methods and indicators, meanwhile there is a clear gap in linking carbon neutral and just transition to this.

The state-of-the-art on specific urban topics has been produced with the help of technical partners, on their topic of expertise. These contributions showed that a large variety of policy areas can impact the domains of carbon-neutrality, resilience, and spatial justice. This wide range of action supports the idea that the benchmarking framework should be flexible enough to consider this different policy areas.

According to the policy documents overview, there is a strong focus in guiding cities to plan and push for a climate neutrality agenda, but there is still a lack of proper understanding of how to tackle implementation gaps, especially on practitioners' skills, private sector involvement, behavioural change and fully integrate the social dimension with the decarbonization pathways.

Then, a benchmarking has been developed according to the previous conclusion and various principles, with the purpose of structuring a system that could be adaptable to each city context and overcome the identified implementation barriers and setbacks.

The first part aims at inspiring cities in the definition of their goals with the description of 5 cities models: the 15-Minutes City, the Water-Sensitive City, the Inclusive City, the Positive Energy District and the Sustainable Food City. Within the UP2030 project, this part of the benchmarking is meant to be used especially during the co-designing visions workshop organized by TSPA. Overall, it is useful for every city outside of the project whose goals are yet to be defined or refined.

The second part of the benchmarking has been framed around three main principles composing what has been called the action filter:

(i) Avoiding conflicting trade-offs between sustainability and resilience

(ii) Overcoming organizational bottlenecks by providing a holistic view on urban implementation gaps (governance capacities, technological capacities, financing capacities, socio-behavioural capacities).

(iii) Spatial justice is considered as the overarching principle of the UP2030 approach that should be taken into account with all types of actions.

The goal of this filter is that cities' actions adapt to the UP2030 approach and avoid implementation gaps and risks such as greenwashing, risk-washing and gentrification.

This document presents the final outline of the benchmarking system. It should serve as a baseline for cities, both within and outside the UP2030 project, to assess their vision and implementation strategies of carbon-neutral actions. This work should also inspire over deliverables of the project such as D2.5 'Report on vision co-design methodology report and its application for pilot shared visions' and D4.4 'Report on monitoring, evaluation and KPI validation in the 5UP-approach implementation pilots 1'. In the upcoming

months, UIC will validate and implement this benchmarking system with the cities and partners involved, in order to see its applicability on each pilot case.

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Annexes

Annex 1: Template to identify gaps, barriers and needs

As part of the identification of gaps, needs and barriers, this template has been facilitated to the UP2030 liaison partners to carry out interviews to key stakeholders and institutional personnel. The aim is to gather as much as possible evidence on the type of barriers to overcome urban governance implementation gaps.

Cities needs and barriers assessment

Interviews' Responses Template[29]

Title of the pilot case	
UP2030 City Partner	
UP2030 Liaison Partner	
Date of the interview	
Interviewer	
Person interviewed	
Contact email	
Organisation/Department	
Type of target group[30]	
Governance dimensions assessment *(Adapt the questions accordingly to the pilot case scope)*	
Governance dimension	**Scope**
1. Systemic and decentralised approach	Focus the question on how the interviewed person identifies gaps to achieve a holistic and decentralised

[29] Template prepared by Universitat Internacional de Catalunya (UIC), WP2 leader. Would be necessary to achieve at least 20-25 interviews.

[30] Choose one type among the following options: Local authority/ National authority / Regional authority / General public / Associations NGOs / SMEs / Private sector not SMEs / Academia Research / Business support organisation / International organisation

	approach among action plans. How does the project interconnect with his/her working field?
Gaps *What is still missing to achieve a proper alignment of a resilient and just neutral carbon city? Which gaps do you see to achieve decentralised infrastructures?* *(Insert the answer max. 100 words)*	
Barriers *What do you think is the main barrier(s)?* *(Insert the answer max. 100 words)*	
Needs *What do you think it is necessary to do to overcome the barrier?* *(Insert the answer max. 100 words)*	
2. Capacity Building	Focus the question on the **knowledge gaps** about neutral carbon, resilience and just transition, from his perspective.
Gaps *Which skills are still missing to achieve neutral carbon, resilient and inclusive city targets?* *Who needs training? Respect to which topics? Technical training or political? The lack of training and need of capacity building is due to lack of motivation, or resources or political mandate?* *(Insert the answer max. 100 words)*	
Barriers What do you think is the main barrier(s)? (Insert the answer max. 100 words)	
Needs What do you think it is necessary to do to overcome the barrier? (Insert the answer max. 100 words)	
3. Community Building	Focus the question on the **engagement gaps** of target groups from institutional (internal departments) to external organisations, stakeholders and civil society.
Gaps	

Do you think the engagement and communication with stakeholders and civil society should be improved? Which are the nature of the community building gaps? Lack of trust? Lack of motivation? Lack of available funding? Lack of guidance? *(Insert the answer max. 100 words)*	
Barriers *What do you think is the main barrier(s)?* *(Insert the answer max. 100 words)*	
Needs *What do you think it is necessary to do to overcome the barrier?* *(Insert the answer max. 100 words)*	
4. Innovation and flourishing environment	Focus the question on how the pilot case encourages innovation and creative processes to **improve citizen's quality of life and livelihood.** Ask how the project foresees to achieve a healthy, cohesive and fair to all (just) action without leaving anyone behind
Gaps *Which gaps may appear in the framing of innovative projects or policies? Do you think there is a gap when tackling social segregation such as gentrification processes?* *Which are the gaps in the city in offering incentives and a flourishing environment for innovation and investments for carbon neutrality, resilience and just city initiatives?* *(Insert the answer max. 100 words)*	
Barriers *What do you think is the main barrier(s)?* *(Insert the answer max. 100 words)*	
Needs *What do you think it is necessary to do to overcome the barrier?* *(Insert the answer max. 100 words)*	
5. Sustainable finance and socio-economic impacts	Focus the question on the short and long-term economic feasibility of the actions (pilot case), considering public and private partnerships. If it applies, discuss the possible socio-economic impacts that can be carried out during and after the implementation of the project.

Gaps *Which are the main sustainable economic mechanisms available or missing?* *How can the economic feasibility be guarantee over time?* *Which gaps you may have from a regulatory perspective?* *(Insert the answer max. 100 words)*	
Barriers *What do you think is the main barrier(s)?* *(Insert the answer max. 100 words)*	
Needs *What do you think it is necessary to do to overcome the barrier?* *(Insert the answer max. 100 words)*	
6. Co-developing monitoring	Focus the questions on how to overcome data collection gaps and monitoring needs as for the pilot case, thinking as a blueprint to scale-up later at wider scales.
Gaps *What information is missing and necessary to map properly the gaps and opportunities toward carbon neutrality?* *What information could you or your organisation provide, or need, from whom? Is there a lack of data, a lack of transparency, a lack of monitoring and evaluation culture, or a lack of learning and up-taking from the monitoring and evaluation happening with no consequences?* *(Insert the answer max. 100 words)*	
Barriers *What do you think is the main barrier(s)?* *(Insert the answer max. 100 words)*	
Needs *What do you think it is necessary to do to overcome the barrier?* *(Insert the answer max. 100 words)*	

Are there any other barriers and needs of overcoming them which are not fitting within the previous categories? Please explain and expand on them.

Annex 2: Existing benchmarking frameworks

As part of the identification if contributions of existing frameworks to carbon neutral, resilience and just transition pillars, the following tables collect the description of indicators, goals, and domains analysed for each benchmarking framework.

Table 5: Sustainable Development Goals (SDGs) Summary of contribution to UP2030 pillars.

Goals and targets (from the 2030 Agenda for Sustainable Development)	***N Goals***	carbon-neutral	resilience	just transition	integrated
Goal 1. End poverty in all its forms everywhere	**5**				**5**
Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture	**5**				**5**
Goal 3. Ensure healthy lives and promote well-being for all at all ages	**9**	**1**		**5**	**3**
Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	**7**				**7**
Goal 5. Achieve gender equality and empower all women and girls	**6**			**6**	
Goal 6. Ensure availability and sustainable management of water and sanitation for all	**6**	**3**			**3**
Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all	**3**	**2**			**1**
Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	**10**			**6**	**4**
Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	**5**	**1**		**1**	**3**
Goal 10. Reduce inequality within and among countries	**7**			**6**	**1**
Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable	**7**			**1**	**6**
Goal 12. Ensure sustainable consumption and production patterns	**8**	**5**	**1**		**2**
Goal 13. Take urgent action to combat climate change and its impacts[3]	**3**		**1**		**2**
Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development	**7**		**6**		**1**
Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	**9**		**8**		**1**

Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	**10**			**6**	**4**
Goal 17. Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development	**19**		**1**	**9**	**9**
TOTAl GOALS	**126**	**12**	**17**	**40**	**57**
%	**100**	**9,5**	**13,5**	**31,7**	**45,2**

Table 6: New Urban Agenda Indicators

Indicator	carbon-neutral	resilience	just transition	integrated
2. Proportion of total adult Population with secure tenure rights to land with (a) legally recognized documentation; and (b) who perceive their rights to land as secure, by sex and type of tenure			**1**	
3. Mortality rate attributed to household and ambient air pollution			**1**	
4. Presence of Women's recognized legal right to property inheritance and ownership			**1**	
7.Renewable energy share in the total final energy consumption	**1**			
10.Unemployment rate by sex, age, persons with disabilities and by city			**1**	
13. Proportion of urban population living in slums, informal settlements or inadequate housing.			**1**	
14. Proportion of the population that has convenient access to public transport disaggregated by age group, sex, and persons with disabilities.		**1**		
15.Ratio of land consumption rate to population growth rate.	**1**			
17.Total expenditure (public and private) per capita spent on the preservation, protection and conservation of all cultural and natural heritage, by type of heritage, level of government, type of expenditure and type of private funding		**1**		
18.Proportion of Municipal solid waste collected and managed in controlled facilities;		**1**		
21: Material Footprint, material footprint per capita, and material footprint per GDP	**1**			
23: Recycling rate, tons of material recycled	**1**			
27: Green Area Per Capita		**1**		
29: Land-use mix		**1**		

30: Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted)	**1**			
31: Median amount of money spent on housing and transportation per household as a percentage of the median annual household income of tenants			**1**	
32: Ratio of the median free-market price of a dwelling unit and the median annual household income			**1**	
33. Gini coefficient at national/city/ urban levels			**1**	
35 Percentage of road length that has dedicated bike lanes (excluding motorways)		**1**		
36 Percentage of road length that has dedicated sidewalks (excluding motorways).		**1**		
38: Percentage of people living in unaffordable housing			**1**	
41 Percentage of cities that have integrated housing policies and regulations in their local development plans			**1**	
43 Percentage of government expenditure dedicated to housing and community amenities			**1**	
44 Percentage of commuters using public transport		**1**		
46 Employment in cultural and creative industries of as proportion of total employment			**1**	
47 Annual number of vocational and technical education individuals trained				**1**
48. Proportion of land under protected natural areas	**1**			
49.Percentage of local governments (LG) that adopt and implement local disaster risk reduction strategies in line with national strategies.		**1**		
50.Percentage subnational/local government budgets dedicated to climate change mitigation and adaptation actions.		**1**		
50.Percentage subnational/local government budgets dedicated to climate change mitigation and adaptation actions.			**1**	
51 Percentage of cities with multi-hazard mapping		**1**		
52 Does the country have a multi-hazard monitoring and forecasting system? /		**1**		
53 The number of cities that have / percentage of urban population that is covered by multi-hazard early warning systems		**1**		
54 Existence of an enforced coastal and/or land management plan in the country		**1**		

55 Percentage reduction in annual final energy consumption in homes using smart monitoring systems.	**1**			
58 Percentage of the total budget that the local / sub-national government have discretion over to decide on priorities (financial autonomy)			**1**	
60: Quality of law	**1**			
63 Number and percent of new population "accommodated" in a plan or city extension		**1**		
70. Number of public water and sanitation utilities participating in institutional capacity development				**1**
71 Percentage of cities and subnational governments with staff trained in formulation, and implementation of urban policies				**1**
74. Percentage of cities/subnational staff trained in financial planning and management				**1**
75. Percentage of cities utilizing e-governance and citizen-centric digital governance tools			**1**	
77 Number of countries that have participated in capacity building workshops on New Urban Agenda				**1**
TOTAL	**8**	**15**	**15**	**5**

Table 7: OECD Life Well-being

Domain	**Indicator**	carbon-neutral	resilience	just transition	integrated
Housing	Dwellings without basic facilities				1
	Housing expenditure			1	
	Rooms per person		1		
Income	Household net adjusted disposable income			1	
	Household net wealth			1	
Jobs	Labour market insecurity				1
	Employment rate			1	
	Long-term unemployment rate				1
	Personal earnings		1		
Community	Quality of support network		1		
Education	Educational attainment		1		

	Student skills		1		
	Years in education		1		
Environment	Air pollution	1			
	Water quality	1			
Civic engagement	Stakeholder engagement for developing regulations		1		
	Voter turnout		1		
Health	Life expectancy				1
	Self-reported health		1		
Life Satisfaction	Life satisfaction				1
Safety	Feeling safe walking alone at night			1	
	Homicide rate				1
Work-Life Balance	Employees working very long hours			1	
	Time devoted to leisure and personal care			1	
	total indicators	**2**	**9**	**7**	**6**
	%	***8,3***	***37,5***	***29,2***	***25,0***

Table 8: EU Green Deal

domain	**Indicators**	**Unit**	carbon-neutral	resilience	just transition	integrated
REDUCING	Greenhouse gas emissions	index	1			
	GHG emissions by sector	% total gross GHG	1			
	Climate related economic losses	EUR per capita				1
	Renewable energy	% Gross final energy consumption	1			
	Primary energy consumption	Million tonnes of oil equivalent	1			
	Household energy consumption	Space heating GJ per capita				1
	Zero-emission vehicles	% of newly registered cars	1			

	Passenger transport	Rail % in inland passenger-km				1
	Freight transport	Rail % in inland freight tonnes-km				1
PROTECTING	Forest amd other wooded land	% land area		1		
	Protected areas	% land area		1		
	Common bird index	All species		1		
	Organic farming area	% of utilised agricultural area		1		
	Nitrate in groudwater	ml/lt		1		
	Consumption of hazardous chemicals	million tonnes		1		
	Premature deaths due to exposure to fine particulate matter (PM 2,5)	rate			1	
	Generation of waste	k per capita	1			
ENABLING	Raw material consumption	tonnes per capita	1			
	Circular material use rate	% material input for domestic use	1			
	R&D expenditure	% GDP		1		
	Population unable to keep home warm	% population				1
	GHG emission intensity of employment	t GHG/employed				1
	High-speed internet	Low settled area | % of households			1	
	Environmental tax revenues	% tax revenue				1
	Environmental protection expenditure	% GDP				1
TOTAL INDICATORS			**8**	**7**	**2**	**8**
%			*32,0*	*28,0*	*8,0*	*32,0*

Table 9: New European Bauhaus

domain	**Indicators**	carbon-neutral	resilience	just transition	integrated
SUSTAINABLE	to repurpose	1			
	to close the loop	1			
	to regenerate				1
BEAUTIFUL	to activate		1		
	to connect		1		
	to integrate		1		
TOGETHER	to include			1	
	to consolidate			1	
	to transform				1
PARTICIPATORY	to consult				1
	to co-develop		1		
	to self-govern				1
MULTI-LEVEL GOVERNANCE	to work locally				1
	to work across levels		1		
	to work globally				1
TRANSDISCIPLINARY	to be multidisciplinary		1		
	to be interdisciplinary				1
	to go beyond disciplinary				1
TOTAL INDICATORS		**2**	**6**	**2**	**8**
%		*11,1*	*33,3*	*11,1*	*44,4*

Table 10: BREEAM

domain	subdomain	Indicators	carbon-neutral	resilience	just transition	integrated
CLIMATE & ENERGY	FLOOD RISK	flood risk study		1		
		runoff management		1		
		SUDS rain water		1		
	DESIGN	heat island		1		
	ENERGY MANAGEMENT	energy efficiency	1			
		local renewables	1			
		future renewables	1			
	INFRASTRUCTURE	urban facilities		1		
	WATER MANAGEMENT	water consumption	1			
	RESILIENCE/FLEXIBLITY	resilience design		1		
	ENERGY MONITORING	smart metering	1			
COMMUNITY	ACCESSIBLE COMMUNITIES	accessible design			1	
		participation			1	
		guidelines for urbanisation		1		
		operation and management		1		
URBAN DESIGN	LAND USE	implementation planning		1		
		reuse of landuse		1		
		reuse of buildings		1		
	DESIGN PRINCIPLES	landscape	1			
		accessibility and design		1	1	
	PUBLIC SPACES	green spaces	1	1		
	INCLUSIVE COMMUNITIES	local demograhy			1	
		affordable housing			1	
	MORPHOLOGY	safety public space			1	
		active facades		1		

		buildings front		1		
	URBAN DESIGN	local architecture heritage				1
	SECURITY	security ilumination			1	
	PROJECT DESIGN	urban continuity			1	
		pedestrian flux				
ECOLOGY	ECOLOGIC STUDY	ecologic analysis				1
	BIODIVERSITY	biodiversity plan		1		
	NATIVE VEGETATION	native flora		1		
	ECOLOGIC CORRIDORS	ecologic corridors				1
TRANSPORT	PUBLIC TRANSPORTATION	TP capacity		1		
		frequency and demand		1		
		TP facilities		1		
	GENERAL POLICIES	proximity to services			1	
	BICYCLES	bycycle networks		1		
		facilities		1		
	TRAFFIC	car associations				
		flexible parking		1		
		local parking				
		pedestrian priority			1	
		mobility plan				1
	LOW CARBON TRANSPORT	electriv vehicles chargers	1			
	TRANSPORT IMPACT	street design		1		
	VEHICLES ACCESSIBILITY	urban freight plan				
RESOURCES	MATERIALS	low impact materials	1			
		local materials	1			
		roads contruction		1		
	WASTE	wate management	1			
	HIDRIC RESOURCES	underground water		1		

	POLUTION	soil polution		1		
ECONOMY	BUSINESS INVESTMENT	priority business sectors				
	EMPLOYMENT	local human resources			1	
		job creation			1	
	BUSINESS CENTRE	new businesses			1	
		investment			1	
BUIDLINGS	NEW BUIDLINGS	residential		1		
		no residential		1		
	REVITALISATION	refurbishment				
TOTAL			**11**	**29**	**14**	**4**
%			*17,7*	*46,8*	*22,6*	*6,5*

Table 11: GBC Europe Communities

domain	**Indicators**	**Points**	%	carbon-neutral	resilience	just transition	integrated
INTEGRATIVE PROCESS	2	5	5				2
NATURAL SYSTEMS AND ECOLOGY	5	9	8		5		
TRANSPORTATION AND LAND USE	6	15	14	2	3	1	
WATER EFFICIENCY	5	11	10	1	3	1	
ENERGY AND GREENHOUSE EMISSIONS	6	30	27	6			
MATERIALS AND RESOURCES	6	10	9	4	2		
QUALITY OF LIFE	8	20	18			6	2
INNOVATION	1	6	5				1
REGIONAL PRIORITY	1	4	4				1
TOTAL	**40**	**110**		**13**	**13**	**8**	**6**
%				*32,5*	*32,5*	*20*	*15*