# U4SSC Thematic Group Digital Transformation for People-Oriented Cities Working Group 4

## Guidelines for Unlocking Net Zero in Cities Through Sustainable Digital Transformation

Presented by:
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20 June 2023

# WORKING GROUP 4 - REFERENCE

**Working Group 4 – Guidelines for Unlocking Net Zero in Cities Through Sustainable Digital Transformation**

- ***Leonidas Anthopoulos (Greece)***

- Scope: This Working Group a set of guidelines which will highlight the enabling role of digital technologies and innovative solutions in driving carbon net zero efforts in different sectors of cities and will provide an integrated approach to urban transformation with a view to accelerate urban transitions to a net zero future.

# PROPOSED WORK PLAN - 1

Contextual and gap analysis of the role of Digital Technologies to carbon net zero cities

Develop methodology (based on KPIs) to assess city net zero progress

Develop :

Assessment framework for city net zero progress

Guidelines for utilizing digital technologies for carbon net zero cities

KPI collection and gap analysis will be the basis for understanding and assessing the state of net zero efforts in cities and communities.

- The working group will develop methods for assessing net zero environment and progress.
- The working group will develop guidelines (architectures, use-cases, exemplars etc.) that would provide cities and communities with simple and easy to understand methods to align their digital transformation to efforts that establish their carbon net zero future.

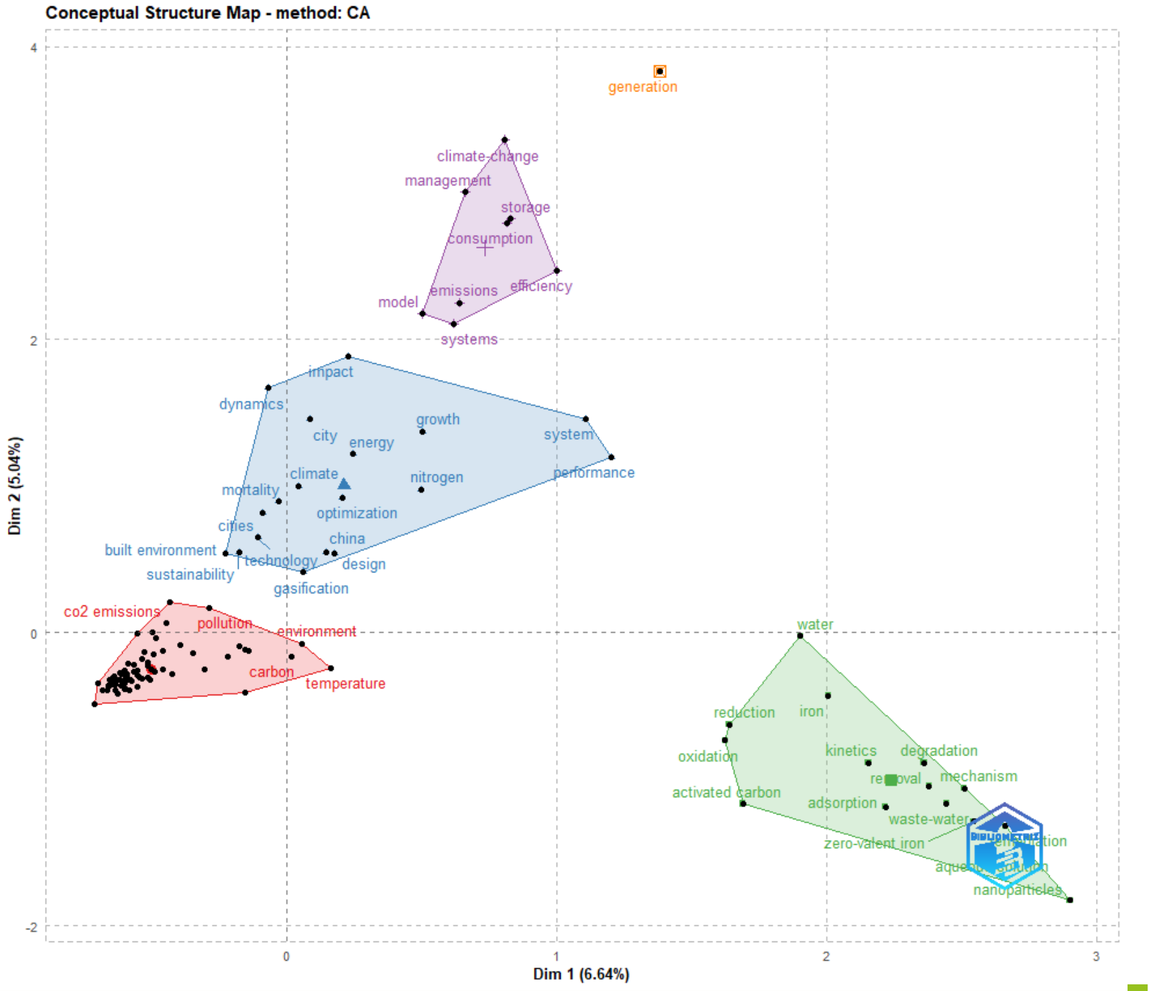
# WORK Plan - Deliverables

| Item | Proposed Activities |
|---|---|
| **Contextual and gap analysis** of the role of Digital Technologies to carbon net zero cities<br>*May 2022* | • Conduct a literature analysis about net zero cities and the role of digital technologies and innovation<br>• Conduct a gap analysis of current applications and use-cases for net zero cities.<br>• Conduct a gap analysis of current methodologies and KPIs.<br>• Prepare final report |
| **Assessment methodology** for city net zero progress<br><br>*January 2023* | • Conduct a thorough review of the collected KPIs to determine which will be included, reworked, better defined or removed from the assessment.<br>• Introduce alternative assessment methodologies |
| **Develop guidelines** for city digital transformation to achieve in carbon net zero<br><br>*July 2022* | • Develop guidelines (architectures, use-cases, exemplars etc.) that would provide cities and communities with simple and easy to understand methods to align their digital transformation to efforts that establish their carbon net zero future. |

# DELIVERABLE 1: Contextual and gap analysis of the role of Digital Technologies to carbon net zero cities

## Bibliometric analysis

| Keywords | Scopus | Web of Science |
|---|---|---|
| “carbon” AND “zero” AND “city” | 566 | 734 |
| “Net Zero” AND “city” | 256 | 173 |
| “Net Zero” AND “city” AND “digital” | 7 | 2 |




**A) “carbon” AND “zero” AND “city”**

Conceptual structure map:

1) Cities are seen as systems, whose energy and performance are measured, while climate change, emissions (nitrogen) and urban design affect mortality.
2) Management models try to measure city system’s efficiency, energy storage, consumption, and emissions.
3) $CO_2$ emissions affect environmental performance and local temperature.

# DELIVERABLE 1: Contextual and gap analysis of the role of Digital Technologies to carbon net zero cities

## Bibliometric analysis

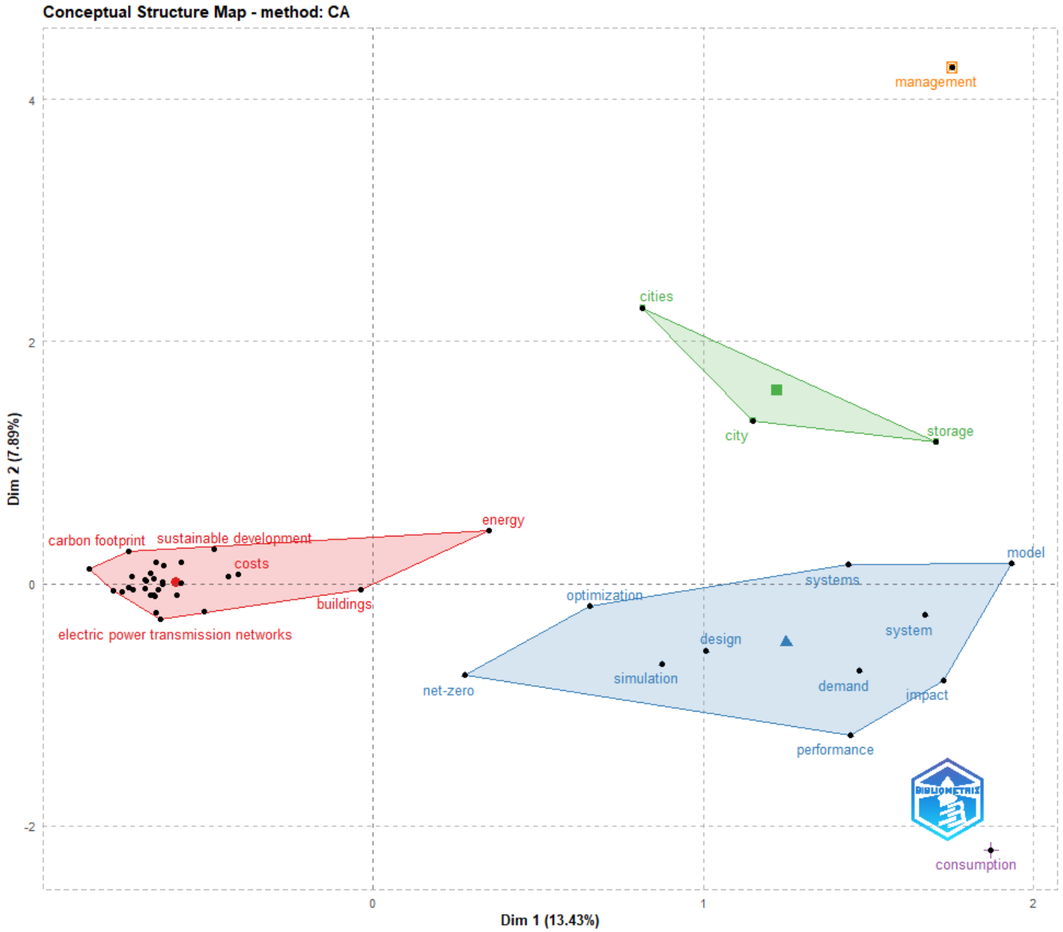
### B) “Net Zero” AND “city”

Conceptual structure map:

1) Cities are seen as energy storage systems.
2) Carbon footprint is seen in terms of its cost and its sources (buildings and transmission networks).
3) Net Zero city is seen as a system, which is simulated, and its performance is calculated.

### C) "Net Zero" AND "city" AND “digital”

Only a few works discuss the role of digital technologies for carbon-neutral cities. Mainly they focus on IoT, energy grids and smart buildings.



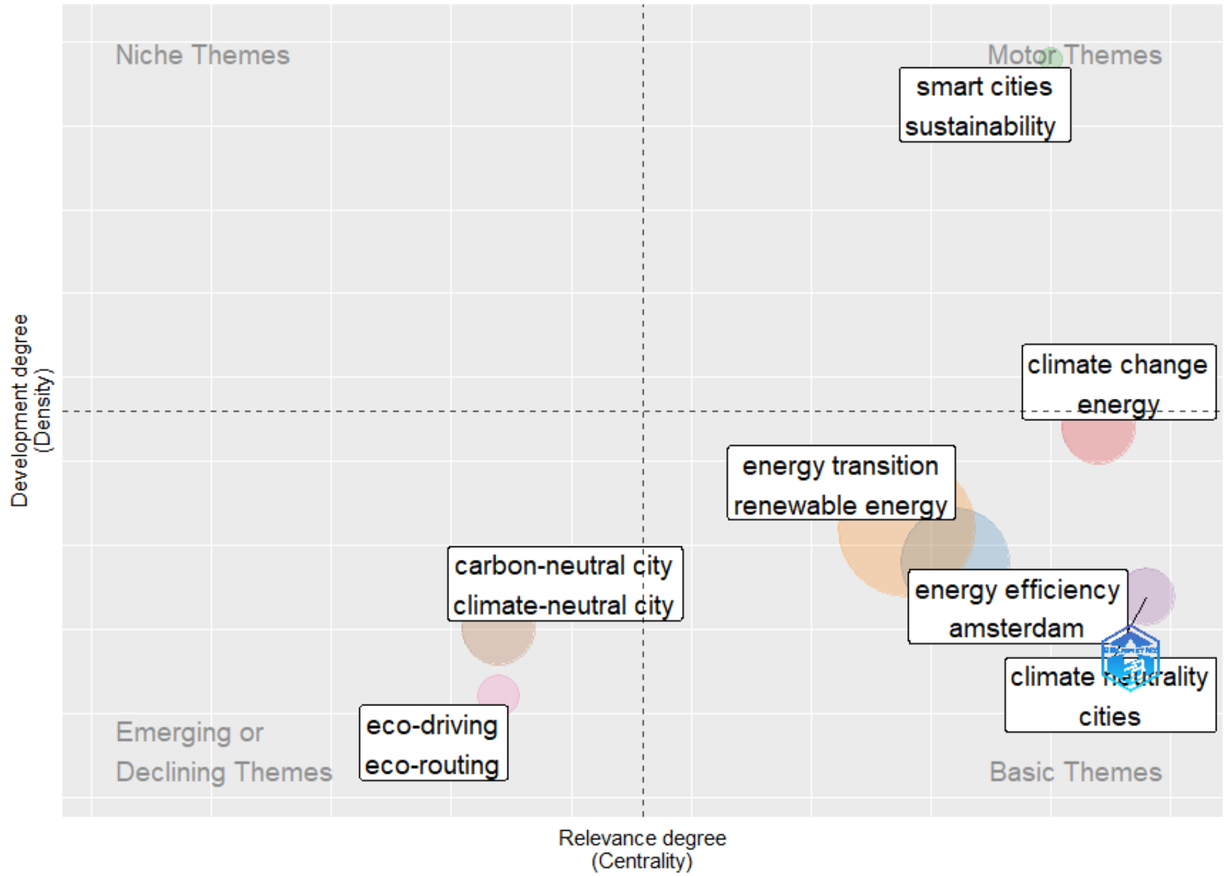
## Bibliometric analysis

**D) “climate-neutral cities”**

The identified articles interrelate urban climate neutrality with sustainability and efficiency in cities, which can be achieved with energy transition to renewable sources, and eco-mobility

**E) “Net Zero energy cities” and “carbon-free cities”**

The combination of these keywords returned articles that do not add anything more to the above analysis since the literature evidence returned is the same as above.



# DELIVERABLE 1: Contextual and gap analysis of the role of Digital Technologies to carbon net zero cities

## Definitions

**A. City:**

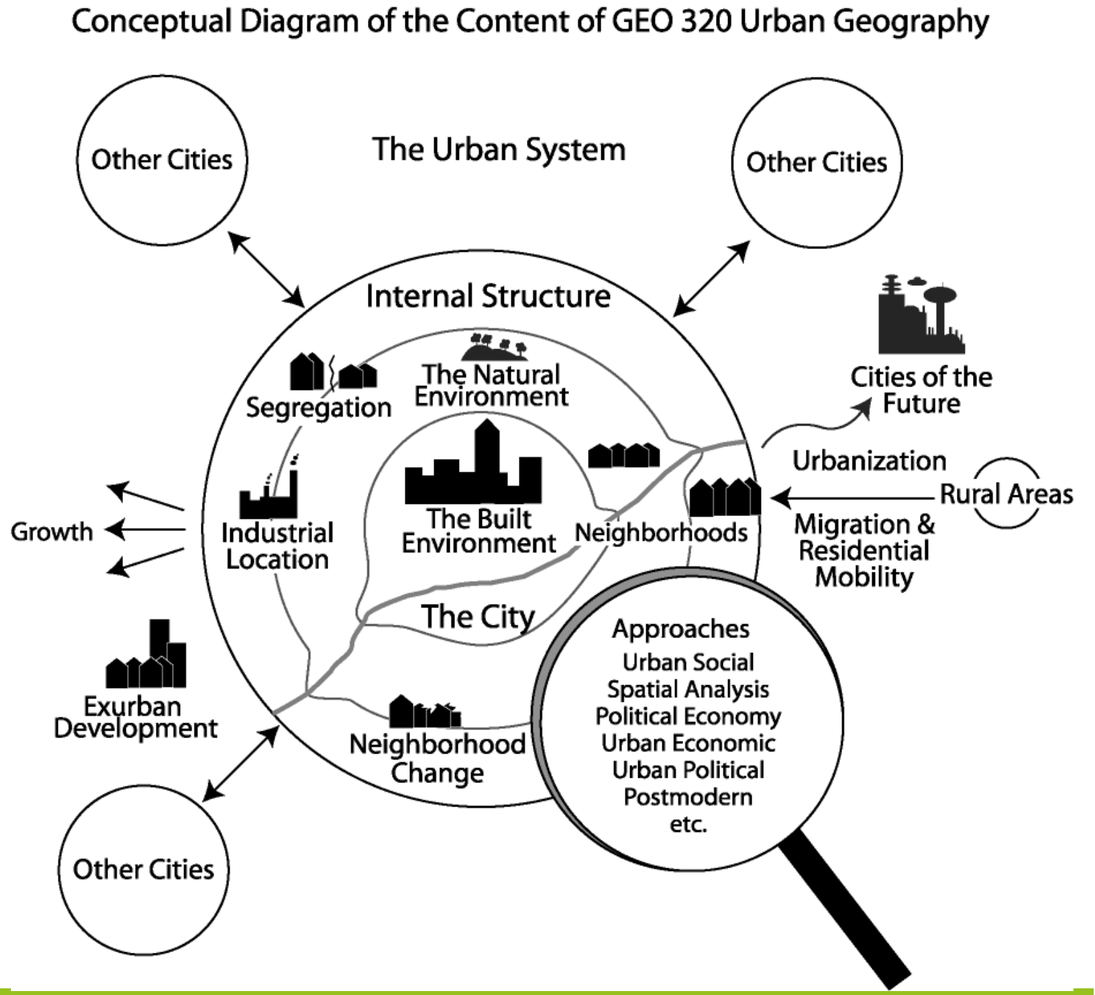
- an urban area, which, according to the United Nations, *typically begins with a population density of 1 500 people per square mile*, although it varies across countries
- According to ISO, *an urban community falling under a specific administrative boundary*

**B. Smart and Sustainable City:** an innovative city that uses ICT and other means to improve quality of life, the efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, and environmental aspects (ITU, 2014a).

**C. Low-carbon city:** the city that decouples urban economy and activities from fossil fuel use and emphasizes energy efficiency, renewable energy, and green transportation (Seto *et al*., 2021).

**D. Net Zero carbon city:** the city that radically reduces GHG emissions from urban activities while simultaneously removes GHG emissions from the atmosphere (Seto *et al*., 2021). *Net zero refers to the balance between the amount of greenhouse gas produced and the amount removed from the atmosphere*.

Synonyms: climate-neutral cities, Net Zero energy cities, carbon-free cities



## Definitions

**E. Emissions of Greenhouse Gases (GHG):** Anthropogenic emissions, less removal by sinks, of the greenhouse gases carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride ($SF_6$) (United Nations, 2007).

**F. Unit of Measurement for GHG emissions:** Annual GHG emissions in gigagrams (Gg). Emissions of $CH_4$, $N_2O$, HFCs, PFCs and SF6 can be converted to $CO_2$ equivalents using the so-called global warming potentials (GWPs) provided in assessments of the Intergovernmental Panel on Climate Change (United Nations, 2007).

**G. Greenhouse Gas Protocol:** Authoritative guidance for communities to account for carbon pollution accurately and consistently (ICLEI, 2022). Internationally accepted GHG accounting and reporting standards (s a step-by-step guide for companies to use in quantifying and reporting their GHG emissions) for business and to promote their broad adoption (WRI, 2004).

**H. Decarbonization:** Decrease the ratio of $CO_2$ or all GHG emissions related to primary energy production (Lodato and Xu, 2021).

**I. Deep decarbonization:** a process by which urban activities achieve zero or near Net Zero carbon dioxide ($CO_2$) emissions. Pathways for deep decarbonization employ systemic changes enabled by future Net Zero electricity grids, such as electrification of vehicles and heating and carbon valorization. They also build on the more typical efficiency and renewable actions cities have pursued for low-carbon development in transformative ways to achieve >80 per cent reduction goals. Low-carbon and deep decarbonization will require behaviour changes, including conservation behaviours and household and industry adoption of new technologies (Seto *et al*., 2021).

**J. Climate neutrality:** bringing all GHG to the point of zero, while eliminating all other negative environmental impacts of an organization (Lodato and Xu, 2021).

**K. Net Zero emission:** alludes to achieving a balance between the whole amount of GHGs released and the amount removed from the atmosphere (Lodato and Xu, 2021).

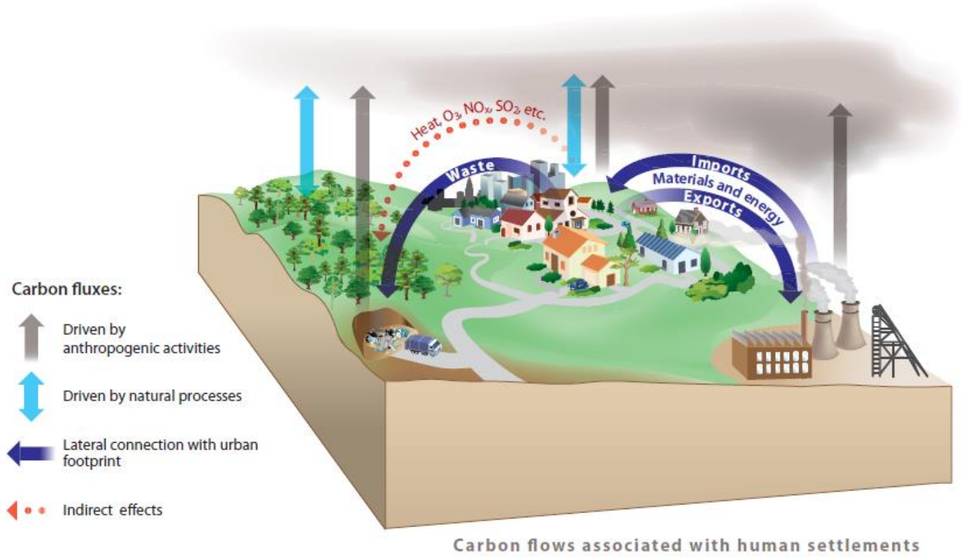
**L. Net Zero carbon emission:** an activity releases Net Zero carbon emissions into the atmosphere (Lodato and Xu, 2021).

**M. Carbon neutrality:** any $CO_2$ emissions released into the atmosphere because of a company's activities are balanced by an equivalent amount being removed (Lodato and Xu, 2021).

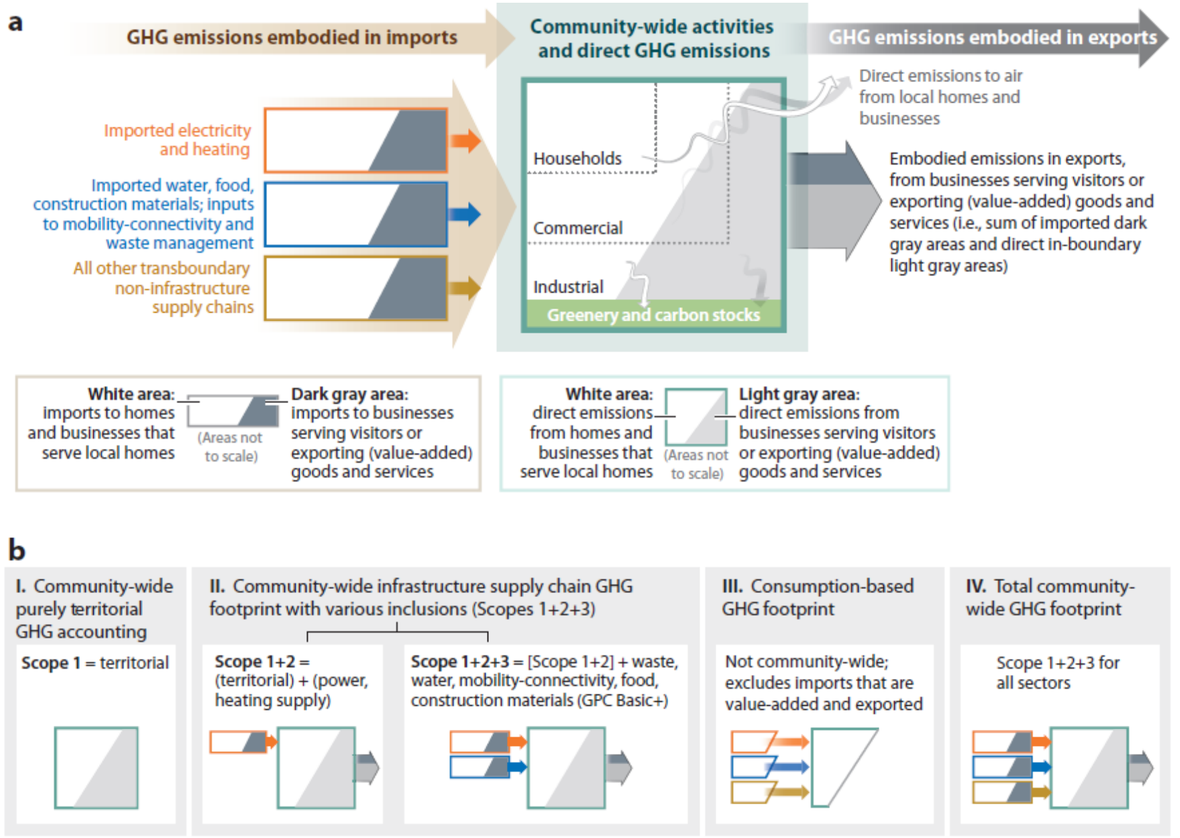
**N. Climate change:** climate change refers to a "change in the state of the climate that can be identified (e.g., using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer" (ITU, 2020).

# DELIVERABLE 1: Contextual and gap analysis of the role of Digital Technologies to carbon net zero cities

## Background




*Urban carbon cycle and its linkages with urban footprint (Seto et al., 2021)*




*In-boundary and transboundary carbon flows (Seto et al., 2021)*
carbon flows are associated with urban activities (residential, commercial, and industrial) and mapped to four urban carbon accounting frameworks

# DELIVERABLE 1: Contextual and gap analysis of the role of Digital Technologies to carbon net zero cities

## Background

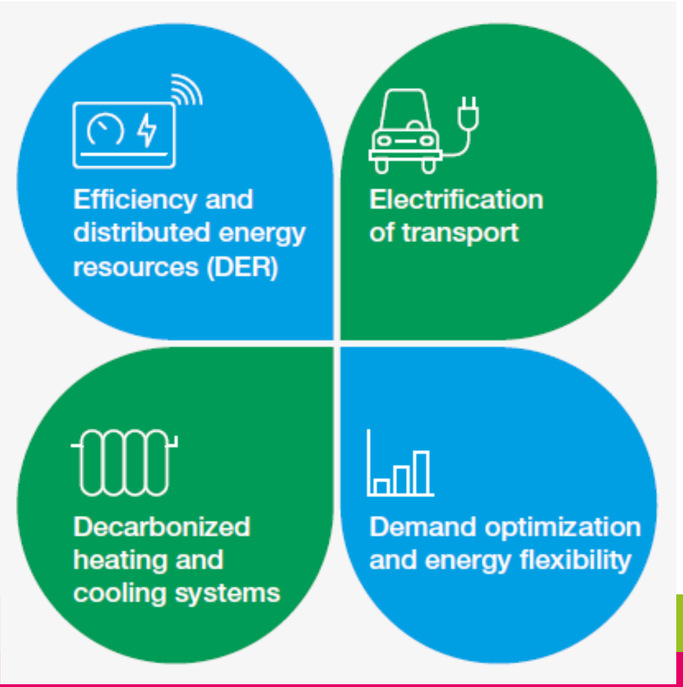
**From a territorial perspective**, a Net Zero carbon city aims to eliminate all carbon emissions produced within the city's administrative boundaries.
*This could be achieved for instance, by moving emission sources out of the city's administrative boundaries (which is not desirable) or by incorporating more carbon sinks such as planting trees*

**From a community-wide infrastructure supply chain footprint** a Net Zero carbon city implies Net Zero emissions for some or all the seven provisioning systems (which are associated with the approximately 90 per cent of global GHG emissions): *energy supply, mobility, construction materials, waste management, wastewater treatment, food systems, and the carbon sequestration benefits of vegetation*.

**From a consumption-based perspective** a Net Zero carbon city implies that all households and government expenditures are Net Zero

**From a total community-wide supply chain footprint** a Net Zero carbon city would imply that not only imports to local households but also exports from local businesses are Net Zero

**the transformation of a city to a Net Zero carbon** is a hard process, since all the urban system's components must transform to new ones that minimize their emissions or collaborate to establish these Net Zero targets.
A city cannot achieve Net Zero performance by focusing only on reducing emissions within its administrative boundaries.
Cities must decarbonize key transboundary supply chains and use urban and regional landscapes to sequester carbon from the atmosphere




*An integrated approach to a Net Zero carbon city (World Economic Forum, 2021)*

# DELIVERABLE 1: Contextual and gap analysis of the role of Digital Technologies to carbon net zero cities

## Gap Analysis: An approach to a Net Zero carbon city

| | | |
|---|---|---|
| International Standards Organization (ISO) | • Climate Action / Our 2050 World<br>• Climate Action Kit (IEC and ISO, 2021).<br>• Building better cities for a Net Zero carbon future.<br>• ISO/TC207: Environmental Management (ISO, 1993).<br>• ISO/TC 207/SC7: Greenhouse gas and climate change management and related activities (ISO, 2007) .<br>• ISO/DTR14069: GHG emission quantification.<br>• ISO14066:2011 Greenhouse gases - Competence requirements for greenhouse gas validation teams and verification teams.<br>• ISO 14064-1:2006, Greenhouse gases – Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals.<br>• ISO 14064-2:2006: focuses on GHG projects.<br>• ISO 14064-3:2006 details principles and requirements for verifying GHG projects.<br>• ISO IWA 42 & BSI: The Net-Zero Guiding Principles through a series of ISO International Workshops. | In line with the London Declaration, a few ISO standards can support the climate agenda (i.e., carbon neutrality (ISO/WD14068) and GHG emission quantification. (ISO/DTR14069): help adapt to climate change, quantify greenhouse gas emissions, and promote the dissemination of good practices in environmental management.<br><br>Moreover, ISO provides with some standards the World Economic Forum (World Economic Forum, 2021) to its integrated approach to Net Zero carbon cities. Some of the standards are: ISO37101:2016; ISO50001:2018; ISO15932:2019;<br><br>ISO/IEC 30145-1:2021; and ISO/CD59004. |
| International Electrotechnical Commission (IEC) | Climate Action; Climate Action Kit (IEC and ISO, 2021); TC111 (IEC, 2018). | Efforts that address SDG13 “Climate Change” to strengthen the disaster resilience of infrastructure; make efficient use of resources; use renewable resources (hydropower, ocean power, solar energy, wind turbines, fuel cell technologies and nuclear instrumentation). |
| International Telecommunications Union (ITU) | Climate Change.<br><br>Frontier technologies to protect the environment and tackle climate change (ITU, 2020).<br><br>ICTs for Carbon Neutrality:<br>• Energy efficiency and smart energy solutions.<br>• Methodologies for the assessment of the environmental impact of the ICT sector:<br>1. ITU-T L.1470: GHG emissions trajectories for the ICT sector compatible with the UNFCCC Paris Agreement.<br>2. ITU-T L.1420: Methodology for energy consumption and greenhouse gas emissions impact assessment of information and communication technologies in organizations.<br>3. ITU-T L.1400: Overview and general principles of methodologies for assessing the environmental impact of information and communication technologies.<br>4. ITU-T L.1410: Methodology for environmental impact assessment of information and communication technology goods, networks, and services.<br>• Circular Economy including e-waste.<br>• Environmental Efficiency for AI and other Emerging Technologies (FG-AI4EE). | ITU standardization efforts to address SDG13, SDG14 and SDG15.<br><br>Recommendations that help the ICT sector measure its energy consumption and GHG emission production. |
| **World Resources Institute (2014)** | **Policy and Action Standard.** | **Provides a standardized approach for estimating the greenhouse gas effect of policies and actions.** |
| **World Resources Institute (2014b).** | Mitigation Goal Standard. | Provides guidance for designing national and subnational mitigation goals and a standardized approach for assessing and reporting progress toward goal achievement. |
| **British Standards Institute (BSI)** | • PAS 2060 Carbon Neutrality.<br>• PAS 2080 PAS 2080:2022 Carbon management in buildings and infrastructure. | Develop standards that Help combat climate change; align with UN SDGs; improve business efficiency (i.e., verify organization’s carbon neutrality) and resilience. |

# DELIVERABLE 1: Contextual and gap analysis of the role of Digital Technologies to carbon net zero cities

## Reducing Urban Demand for Energy and Materials

**Pathway 1 - Integrated Urban Spatial Planning:** Four key characteristics of urban form can affect the produced GHG emissions: *density, land use mix, connectivity and accessibility*

**Pathway 2: Increasing Single-Sector Efficiency:** Within each sector (buildings, transportation and vehicles, and green infrastructure), new technologies offer opportunities for reducing resource requirements

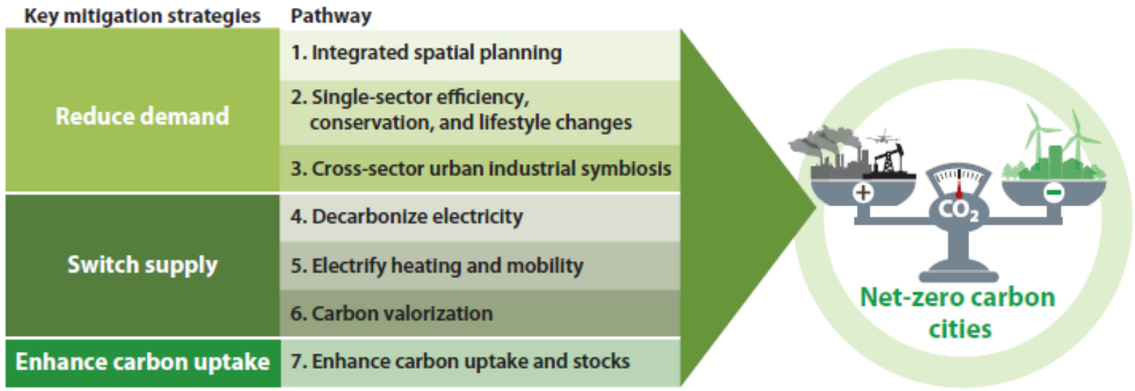
**Pathway 3: Cross-Sector Urban Industrial Symbiosis:** Urban industrial symbiosis refers to the exchange of waste heat and materials across sectors

**Pathway 4: Decarbonize Electricity:** a Net Zero carbon electricity grid can provide Net Zero carbon energy

**Pathway 5: Electrifying Mobility and Heating/Cooking Systems:** The Net Zero carbon electricity grid can contribute to a Net Zero carbon future only when the primary urban activities (i.e., mobility, heating/cooking, etc.) transform to zero-carbon electricity

**Pathway 6: Renewable Fuels and Materials via Carbon Valorization:** Carbon valorization is the process that converts $CO_2$ into value-added products **through a range of technologies**

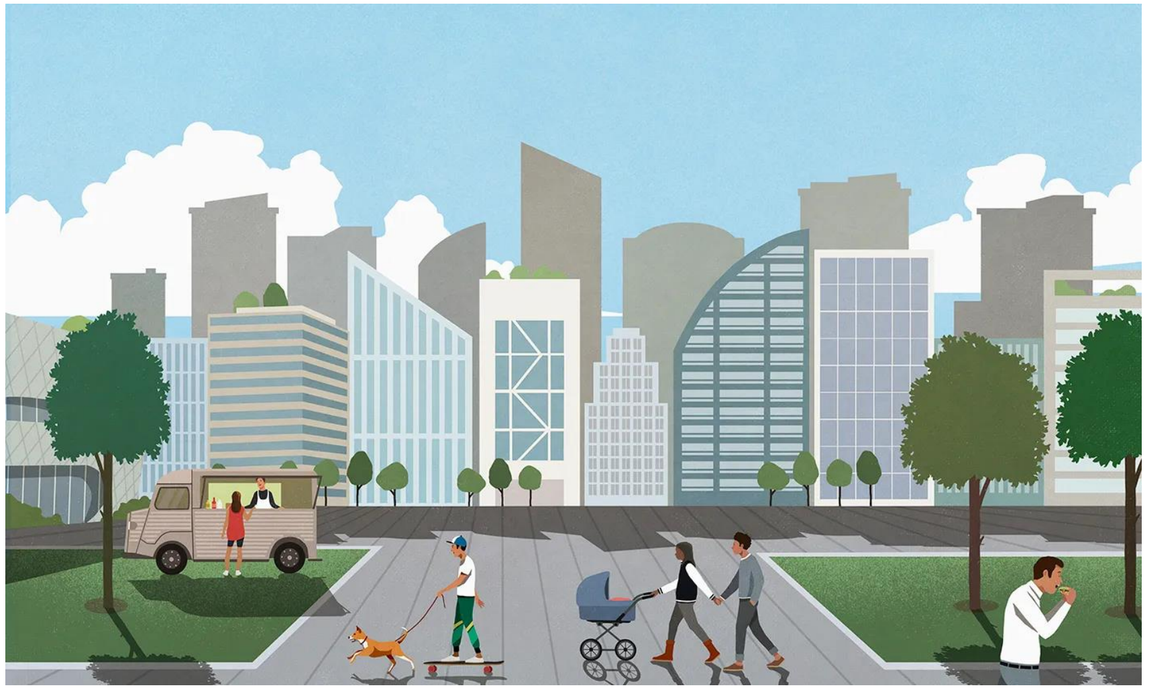
**Pathway 7: Enhancing Urban Carbon Uptake and Stocks:** carbonation of cement; photosynthetic carbon uptake by green plants




Framework for urban deep decarbonization (Seto *et al*., 2021)

## Reducing Urban Demand for Energy and Materials: examples

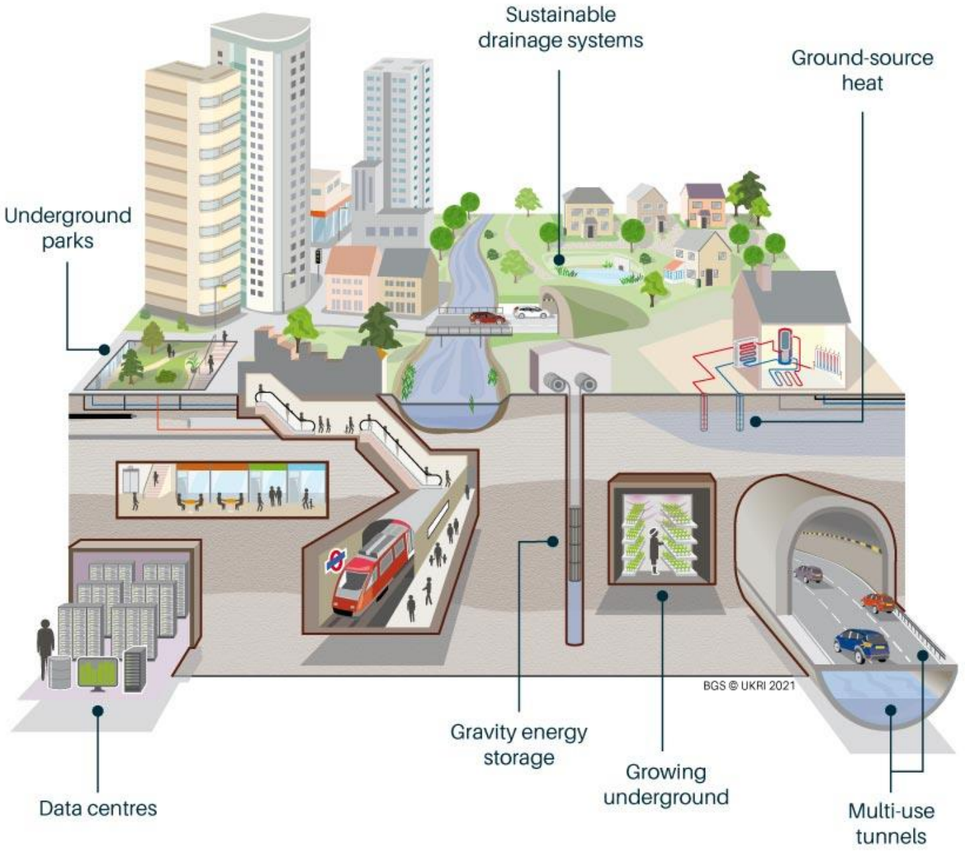
- **Central city walking cities** are less able to install solar photovoltaic (PV) systems, but they are ideal for walkable active transport and micro mobility, as well as biophilic urbanism in the form of green roofs and green walls.
- **Transit city corridors** are better for solar PV and batteries, and ideal for transit, micromobility, and active transport. They have also some potential in circular economy.
- **The middle and outer suburbs of the automobile area** are good for solar PV, as demonstrated in Australian cities where most of the poorer outer suburbs installed PV first. They are also good for circular economy processing and permaculture, which need more space; however, these areas are likely to require electric cars and buses.
- **Rural villages and peri-urban areas** will need to form new localized centres to maximize benefits from solar-PV-batteries electromobility. Peri-urban areas are likely to be able to have some rail access but are more likely to need EV car-share or cooperative bus services to link them to it, and hence to the city. Local transport can use such vehicles, as well as electric bikes



# DELIVERABLE 1: Contextual and gap analysis of the role of Digital Technologies to carbon net zero cities

## The role of ICT to a Net Zero carbon city

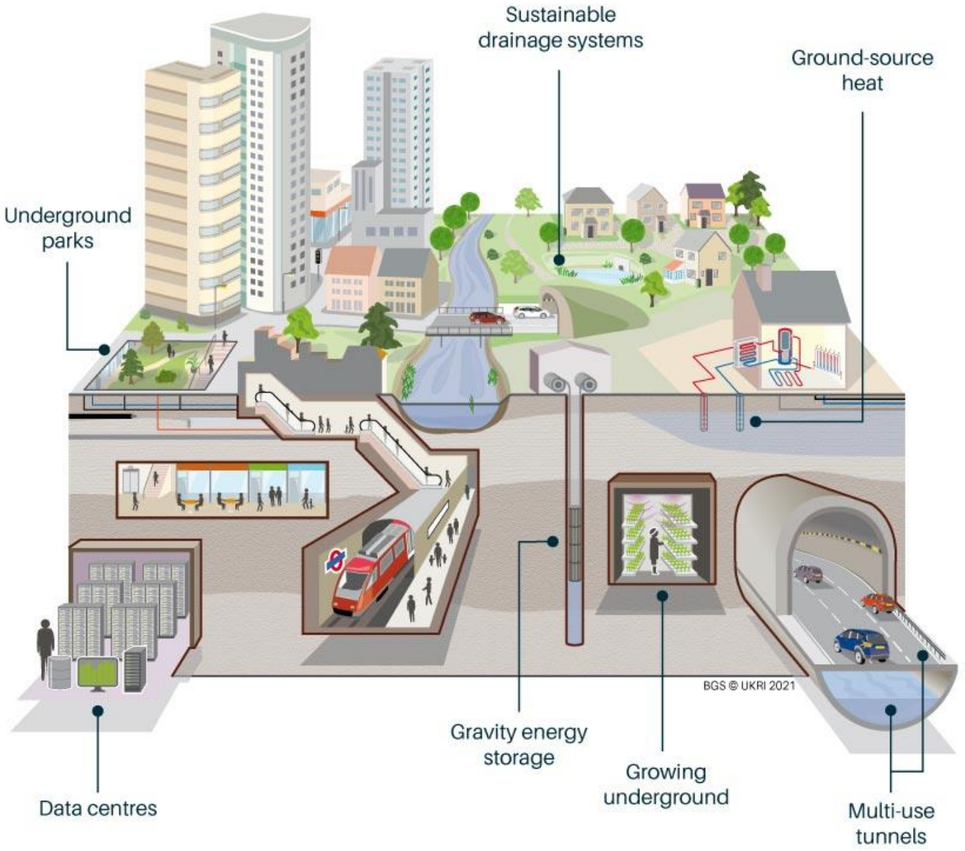
- **ICT-based measurement:** (real-time) sensing and crowdsensing, which can calculate GHG (and other) emissions and measure systemic performance during particular periods of time
- **ICT-based electric mobility:** smart transportation systems can integrate ICT with EV and maximize mobility's efficiency in meeting demands and minimize emissions.
- **ICT-based efficiency:** ICT can play a significant role in maximizing this efficiency.
- **ICT frontier technologies:** technologies that can be used to address climate change (i.e., Artificial Intelligence (AI), Internet of Things (IoT), 5G, Clean Energy Technologies, Digital Twin, Robotics, Space 2.0, Digitalization and big data, blockchain, etc.)
- **ICT efficiency:** the ICT systems must also be energy efficient
- **Organizational activities that are based on the ICT:** web-based services to avoid physical transactions; smart-work, teleconferencing and tele-education; install and use energy-efficient office machines; install and use green data centres; adapt Building Energy Management Systems (BEMS)



## Other measures to establish a Net Zero carbon city

- **Community awareness:** raising awareness requires extensive and successful communication efforts, which should follow modern methods like gaming, simulation, citizen assemblies' structuring, motivation and profiting, which are being performed locally and globally (Creutzig and Kapmeier, 2020). Moreover, community motivation via the circular economy and individual savings can also contribute to social engagement.
- **Carbon-freeing literacy:** the community must realize the context of shifting from a fossil-fuel life to a carbon-free life, and this mitigation goes beyond policy and technology, to even attitude changes (i.e., car avoidance, gardening, etc.). Educating the community is a challenge, which should focus on energy demand reduction and energy flexibility (Shimoda *et al*., 2020).

*ISO/DIS 14066 for instance, works on competence requirements about validation and verification of environmental information and has delivered the ISO14066:2011 Greenhouse gases - Competence requirements for greenhouse gas validation teams and verification teams*



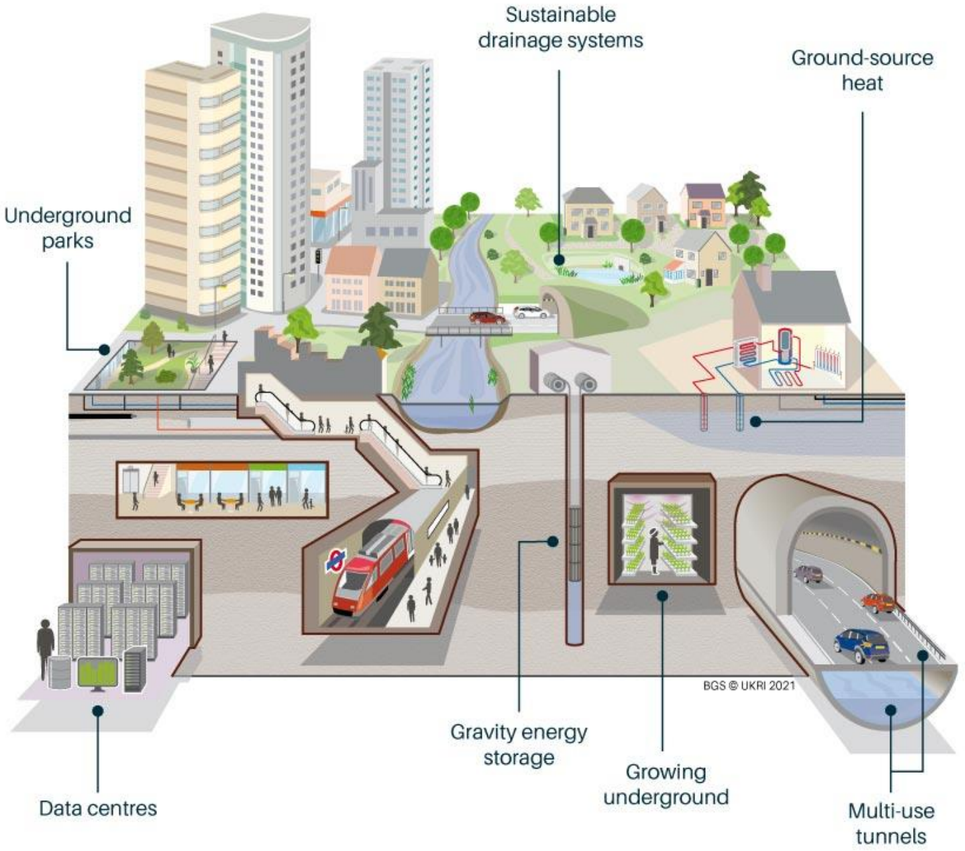
# DELIVERABLE 1: Contextual and gap analysis of the role of Digital Technologies to carbon net zero cities

## Conclusions

1) Cities are seen as systems for energy storage and consumption.
2) Climate change, emissions and urban design affect environmental performance, local temperature, and community's mortality.
3) Management models try to measure city system's efficiency, energy storage, consumption, and emission production.
4) Carbon footprint is seen for its cost, and its sources (buildings and transmission networks).
5) Urban climate neutrality is associated with sustainability and efficiency in cities, which can be achieved with energy transition to renewable sources, and eco-mobility.

Standardization provides:

- toolkits for GHG measurements and pathways for a Net Zero carbon future;
- management tools and verification mechanisms that can support businesses and organizations in the GHG Net Zero mitigation process;
- standards that focus on the ICT sector



# DELIVERABLE 2: Methodology to assess city net zero progress

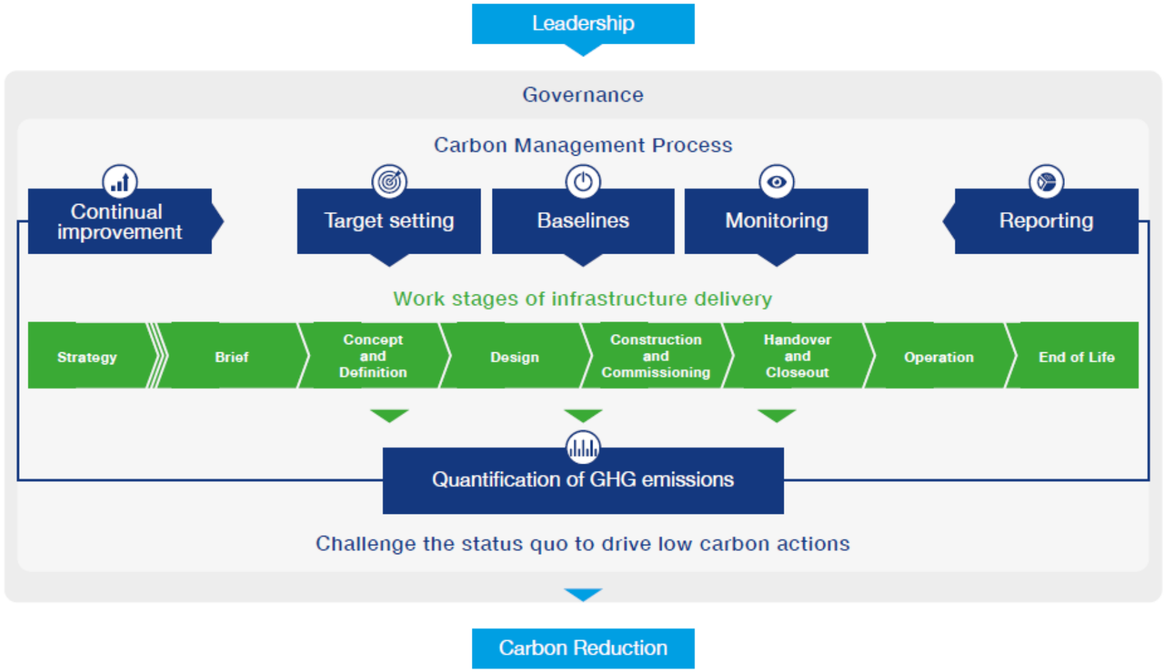
## Methodology I: “Carbon-performance” assessment

- Calculates the GHG emissions produced, and the carbon consumption performance
- Considers the entire life cycle of a product or service

**GHG emissions by sector**

1. Buildings (municipal, industrial, commercial, and residential).
2. Businesses and labour size (industry, service, and farming sectors).
3. Transportation (public and private), which now evolves to an EV charging network.
4. Public lighting (street and open space lighting, fountain operation).
5. Water and sewage treatment and distribution.
6. Waste chain operation (collection, delivery and processing).
7. Telecommunication networks.
8. Land uses.

$$GHG\ emissions = Activity\ data\ \times Emission\ factor$$




*PAS 2080 Carbon Management Process (Construction Leadership Council, 2019)*

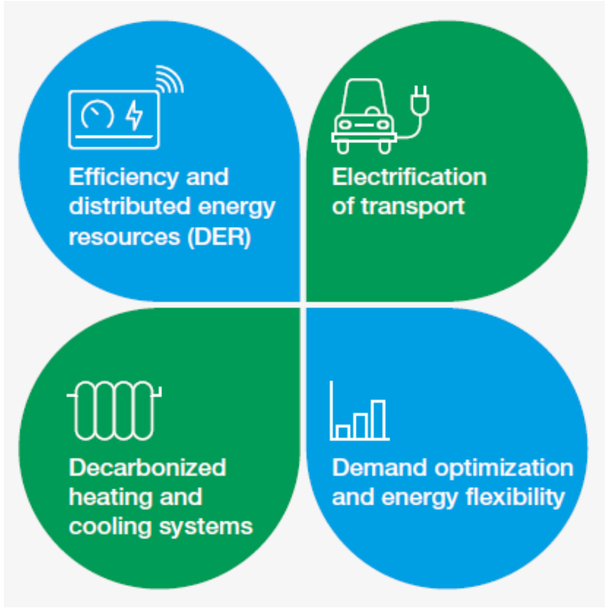
# DELIVERABLE 2: Methodology to assess city net zero progress

## Methodology I: “Carbon-performance” assessment

- Calculates the GHG emissions produced, and the carbon consumption performance
- Considers the entire life cycle of a product or service

**Carbon consumption maturity model:** Inspired by the SSC maturity model

- **Energy Efficiency:** evaluate how energy efficiency, has been improved in the city, especially based on the ICT
- **Mobility electrification dimension:** evaluate the progress of mobility electrification in the city, especially based on the ICT
- **Demand control dimension:** evaluate how energy demand and general carbon behaviour in the city has changed, especially based on the ICT




*An integrated approach to a Net Zero carbon city (World Economic Forum, 2021)*

# DELIVERABLE 2: Methodology to assess city net zero progress

| | Strategy | ICT Infrastructure | Infrastructure upgrades | Services and utilities | Assessment | KPIs performance |
|---|---|---|---|---|---|---|
| **Maturity Level 1** | The overall strategy is developed | Key infrastructures and data are identified in the strategy | Key aspects on infrastructure upgrades are identified in the strategy | Strategy and priorities for services and utilities on city level are identified | Assessment plan is ready | Long-term targets for KPIs are set for city carbon neutral strategy and baseline values for KPIs are collected |
| **Maturity Level 2** | Carbon neutrality initiatives are aligned with the strategy | ICT infrastructures are operated, and corresponding data are produced independently | Methodology to identify and implement upgrades are agreed | Domain services and utilities contribute to carbon neutrality individually | Self-assessment of infrastructure development and services are carried out | Interim KPI targets for maturity level 2 are achieved |
| **Maturity Level 3** | Evaluation of carbon neutrality initiatives is carried out | Accessibility of ICT infrastructures and data is improved | Infrastructure upgrades are carried out independently by different sectors. | Services and utilities focus on carbon neutrality public value generation.<br>Utility and service operation is monitored and analysed to improve carbon neutrality performance | User satisfaction assessments are carried out | Interim KPI targets for maturity level 3 are achieved |
| **Maturity Level 4** | Strategy is developed for improving integration and cooperation | Cross-domain ICT infrastructures and data exchanges are provided with interoperability capabilities | Cross-domain infrastructure upgrades are performed | Cross-domain carbon neutrality initiatives | Stakeholders' satisfaction assessments are carried out | Interim KPI targets for maturity level 4 are achieved |
| **Maturity Level 5** | Improvement and optimization potential is explored | Continuous development of infrastructure and data provision are carried out | Continuous improvements with state-of-the-art technologies for carbon reduction | Continuous improvements of services and utilities are made by applying advanced state of the art technologies for carbon reduction | Systematic assessment process is established with corresponding actions | Long term targets for KPIs are achieved |

# DELIVERABLE 2: Methodology to assess city net zero progress

| Dimension | Topic | KPIs | Current KPI value for maturity level 1 | Interim target KPI value for maturity level 2 | Interim target KPI value for maturity level 3 | Interim target KPI value for maturity level 4 | Long-term target KPI value for maturity level 5 |
|---|---|---|---|---|---|---|---|
| **Energy Efficiency** | ICT infrastructure | Household carbon neutral upgrades | Baseline collected | Interim target value e.g., 30% | Interim target value e.g., 40% | Interim target value e.g., 60% | Target value e.g., 80% |
| | | Electricity system based on renewable sources | Baseline collected | – | Interim target value e.g., 30 mins. | Interim target value e.g., 25 mins. | Target value e.g., 15 mins. |

# DELIVERABLE 2: Methodology to assess city net zero progress

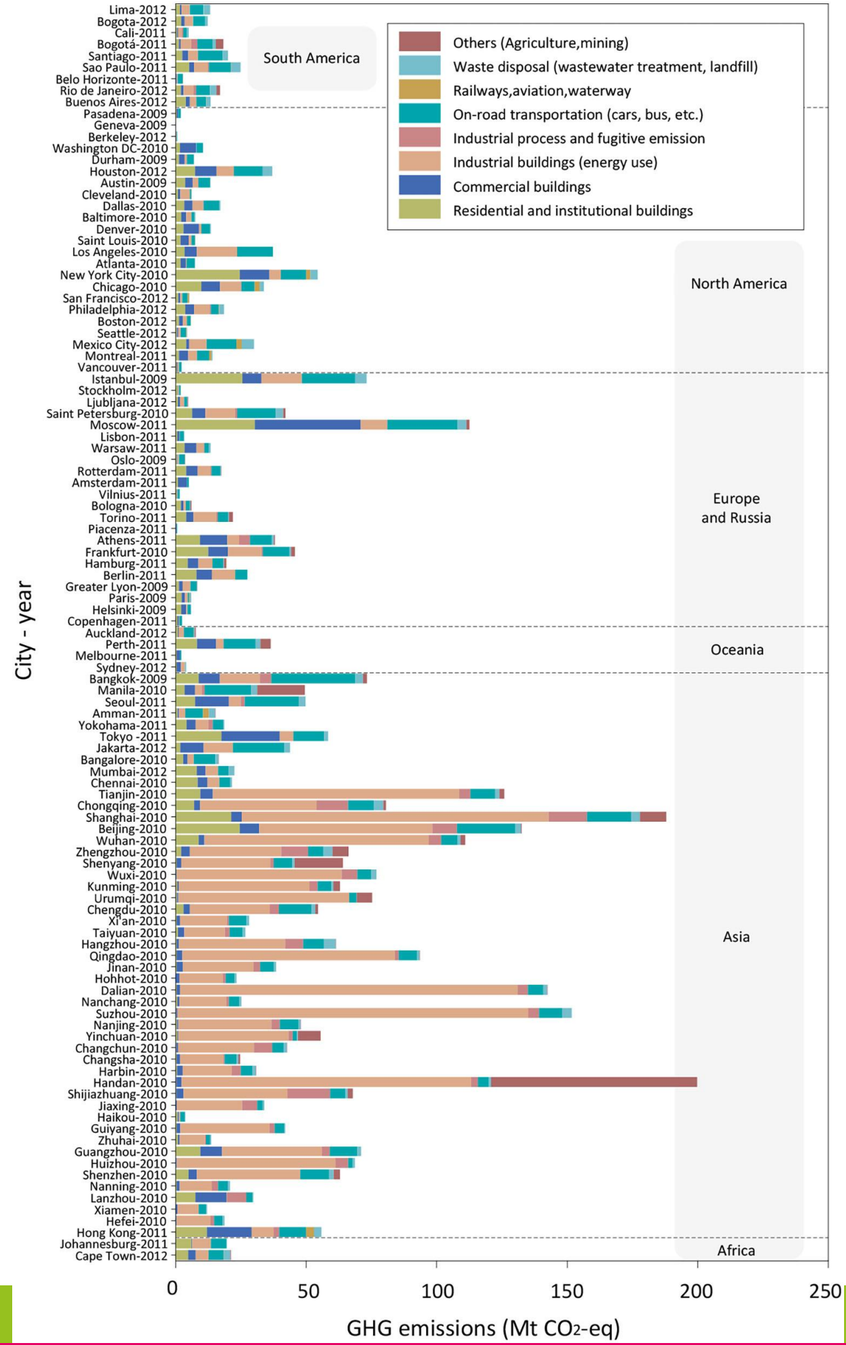
## Methodology II: Carbon Neutrality Progress assessment

- Calculates the effectiveness of carbon reduction policies

- energy-related GHG emission inventories (by eight urban sectors:
  - residential and institutional buildings;
  - commercial buildings;
  - industrial buildings (energy use);
  - industrial process and fugitive emissions;
  - on-road transportation (cars, buses);
  - railways, aviation, and waterways;
  - waste disposal (wastewater treatment, landfills);
  - and other (agriculture and mining)

*for 167 globally distributed cities, from 53 countries, with information from different sectors*

- the total GHG emissions ranged between 3.5 kt $CO_2$-eq and 199.7 Mt $CO_2$-eq.
- the top 25 (15%) of the 167 cities accounted for 52 per cent of the total GHG emissions, which are mainly from Asian and European countries




*Sector contribution to GHG emissions of global cities* (Wei *et al.*, 2021)

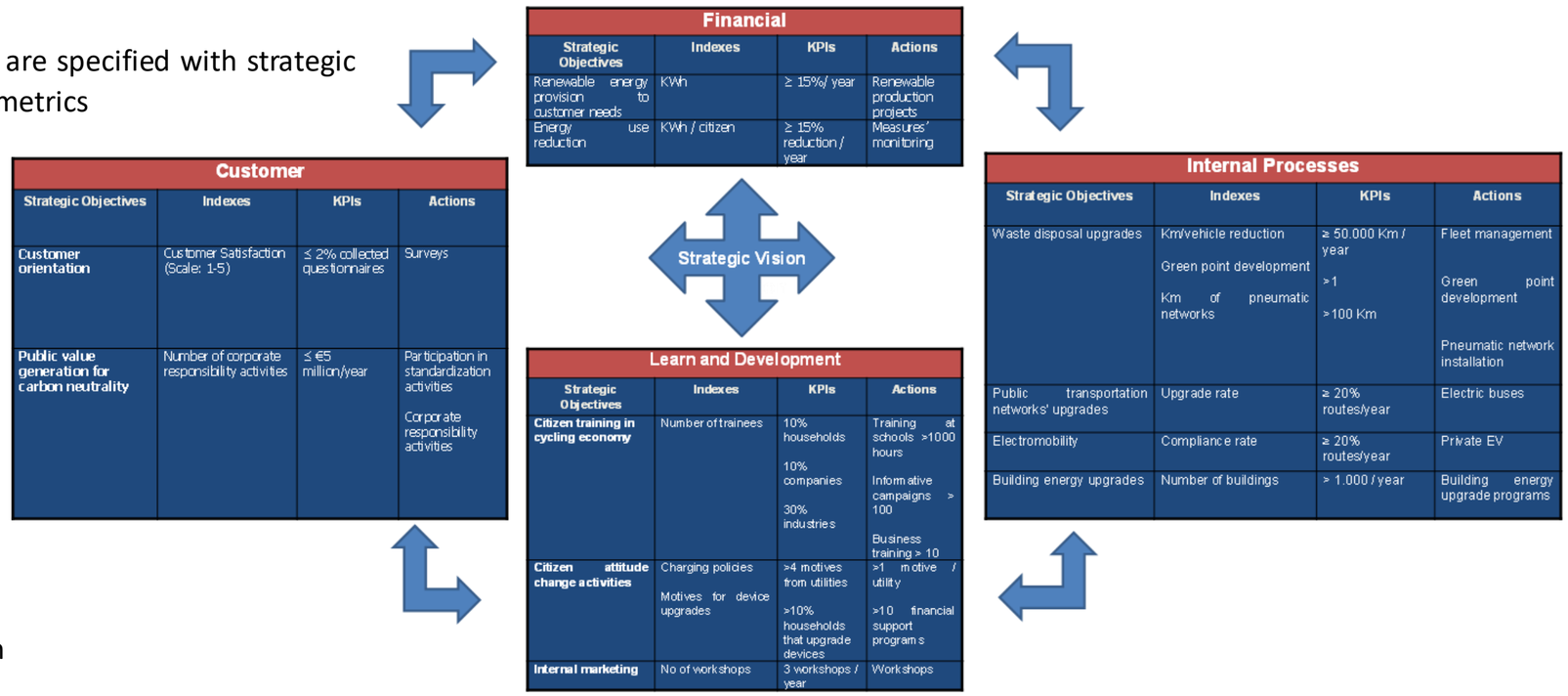
# DELIVERABLE 2: Methodology to assess city net zero progress

## Methodology III: strategic performance assessment

- Calculates the effectiveness of a local strategy
- a strategy is specified with strategic targets, which in turn are specified with strategic objectives, whose establishment is measured with specific metrics

- Objectives are extremely useful because they transform strategic vision into measurable targets
- enable progress/performance measurement
- oblige the organization to be focused

- **carbon neutrality objectives**
  - Achieve Net Zero emissions by a specified year (i.e., 2070)
  - Reduce emissions intensity of GDP (%)
  - Reduce emissions (tons)
  - Generate energy from renewable resources (%)
  - Organization's contribution to GHG emission reduction in the corresponding sector




*Sector contribution to GHG emissions of global cities* (Wei *et al.*, 2021)

# DELIVERABLE 2: Methodology to assess city net zero progress

## Conclusions

Three different assessment approaches

1. based on existing standards and on previous standardization efforts for SSC development and concerns the *city carbon performance*; measured according to the produced GHG by a city and it is calculated with the individual sector's assessment and the combination of the results (associates carbon neutrality with digital transformation)
2. The second approach is based on literature findings and concerns the carbon neutrality progress assessment (how different countries have targeted carbon neutrality by 2050)
3. The third approach is the balanced scorecard to align carbon neutral initiatives to corresponding strategic objectives and indexes

# DELIVERABLE 3: Guidelines for city digital transformation to achieve in carbon net zero

## Use cases

***1) Central walking cities***

- Walkable active transport:
  - health-promoting and supports sustainable living
  - pedestrian-friendly neighbourhoods (highly connected streets, high population density, mixed land use, good access to destinations and transit, and sidewalk provision)
- Micromobility:
  - low-speed modes of transport based on the use of electricity
- Biophilic urbanism:
  - the use of natural elements as purposeful design features in urban landscapes to address climate change issues in rapidly growing economies
  - Portland (Policy/Programme: Green Streets policy, Biophilic element: Green street).
  - Chicago (Policy/Programme: Millennium Park, Biophilic element: Urban park).
  - Toronto (Policy/Programme: Green Roofs bylaw, Biophilic element: Green roofs).
  - Berlin (Policy/Programme: Biotope Area Factor, Biophilic element: Green roofs, Green walls, Community gardens).
  - Singapore (Policy/Programme: Garden city, City in a garden, Biophilic element: Green roofs, Green walls, Street trees, Park connectors)

# DELIVERABLE 3: Guidelines for city digital transformation to achieve in carbon net zero

## Use cases

***2) Transit city corridors***

- solar photovoltaic (PV) systems and batteries
- transit, micromobility, and active transport *(presented previously)*
- Circular economy

- PV systems:
  - direct conversion of sunlight into electricity
- Circular Economy:
  - an economic model aimed at the efficient use of resources through waste minimization, long-term value retention, reduction of primary resources, and closed loops of products, product parts, and materials within the boundaries of environmental protection and socio-economic benefits

## Use cases

***3) The middle and outer suburbs of the automobile area***

- solar photovoltaic (PV) systems and batteries *(presented previously)*
- Circular economy permaculture.
- Electric cars and buses

- Circular economy permaculture:
  - characterized by sustainability, diversity, stability, and durability with the integration of all ecosystem components
  - using nature as a guide
- Electric cars and buses:
  - battery electric vehicles (BEVs), fuel cell electric vehicles (FCHEVs) and hybrid electric vehicles (HEVs)

# DELIVERABLE 3: Guidelines for city digital transformation to achieve in carbon net zero

## Use cases

***4) Rural villages and peri-urban areas***

- Electric transit
  - Recharging stations for electric cars and electric transit (buses, trains, and trams) will be needed in certain parts of a city where solar collectors can be built to satisfy this demand
- EV sharing: separation of ownership and use
  - ride-sourcing EV and self-service EV

# DELIVERABLE 3: Guidelines for city digital transformation to achieve in carbon net zero

## Use cases

***5) The "100 Climate-neutral Cities by 2030" initiative***

- Based on the European Grean Deal
- support 100 European cities in their transformation to climate neutrality by 2030
  - Build a multilevel and co-creative process formalized in a Climate City Contract that, while adjusted to the realities of each city
  - Promote citizens to become agents of change through bottom-up initiatives and innovation and through new forms of governance.
  - Help cities access the financial means.
  - Foster a just transition via the UN SDGs.
  - Bring many co-benefits (e.g., improved air quality, job creation), healthier lifestyles, stimulating the positive effects of new sustainable mobility concepts.
  - Identify European, national, regional and local policy gaps, as well as R&I priorities to contribute to the goals of the European Green Deal.
  - Support the development of drivers of transition under five key enablers:
  - A model for the transformation of cities to innovation hubs
  - New forms of participative and innovative city governance
  - An economic and funding/financing model for climate action
  - An "integrated urban planning" model
  - Smart systems and data platforms.
  - Create synergies with and between existing European climate initiatives and stakeholders.
  - Align with other missions and initiatives that support the Green Deal
  - Collaborate on innovation with the European business to enhance the competitiveness of European industry in the global markets

# DELIVERABLE 3: Guidelines for city digital transformation to achieve in carbon net zero

## Guidelines for city digital transformation to establish carbon neutrality

- **ICT to enhance efficiency:** energy, water, and mobility services and commuting reduction, which are fundamental to a city's prosperity and sustainability.
- **ICT to enhance buildings' efficiency:** utilize the ICT to enhance buildings' features for carbon neutrality.
- **Green ICT for city economic growth:** connectivity infrastructure, citizen empowerment, ICT upskilling addressing carbon behavioural change. Some more examples concern low- (zero-) carbon electric grids, automated disassembly and separation of waste using AI and robotics.
- **ICT and city data ecosystems for carbon-neutral and smart communities, which deal with climate change and emergency management:** disruptive weather patterns and phenomena, through climate impact modelling for optimal mitigation and adaption.
- **ICT to transform citizen behaviour:** smart services and applications, accompanied by training to assist citizens' changing their behaviour to carbon neutrality.


A proper framework that respects digital solutions enables:

i) cross-domain data management (interoperable platforms and mechanisms for data sharing);

ii) city custom digital transformation (i.e., by preserving their security and flexibility, as well as their data and technological sovereignty).

# DELIVERABLE 3: Guidelines for city digital transformation to achieve in carbon net zero

## Guidelines for city digital transformation to establish carbon neutrality

A carbon neutral pathway can align to digital transformation with the following measures:

- **ICT for energy efficiency, aiming at zero emissions.**
- **Deployment of renewable energy sources integrated with the ICT networks.**
- **ICT for efficient mobility (including active mobility, micromobility, EV, EV sharing, etc.) combined with smart multimodal solutions such as mobility as a service (MaaS), and automation.**
- **ICT that integrates circular economy in a close-loop system for minimizing resource inputs and waste, pollution, and carbon emissions.**
- **ICT-based economic growth with upskilling that addresses carbon-related behavioural change.**
- **ICT to capitalize bioeconomy and create essential carbon sinks (i.e., biomass).**
- **Green ICT pathway to optimize the carbon footprint of Gigabit society.**

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# Thank you!