Toolkit on Digital Transformation for People-Oriented Cities and Communities

6

Module 6:
Digital Transformation to Reduce the Environmental Impact of Cities

Jointly developed by: ITU, UN-Habitat, WMO, UNDP, UNEP DTU

Module 6:
Digital Transformation to Reduce the Environmental Impact of Cities

- This Module of the Toolkit on Digital Transformation for People-Oriented Cities and Communities focuses on employing digital transformation to reduce the environmental impact of cities.

- Cities and communities that are starting on their digital transformation journey will find the resources highlighted within this Module useful toward reducing their environmental impact .

- This Module is also useful for cities and communities that have already made some headway into their digital transformation process but would like to validate their progress on the environmental impact front.

Module 6:
Digital Transformation to Reduce the Environmental Impact of Cities

1. The Impact of Cities on the Environment
2. Opportunities Using Digital Transformation
3. Key Digital Transformation Tools for Reducing the Environmental Impact of Cities
   - Tool #1 - Sustainable policies and planning through implementing SDG 11
   - Tool #2- Key Performance Indicators
   - Tool #3 - Circular Economy
   - Tool #4 - Sustainable Buildings
   - Tool #5 - Intelligent Traffic Management
   - Tool #6 - Smart Water Management
   - Tool #7 - Smart Sewer Management
   - Tool #8 – Digital Twin
   - Tool #9 - Integrated Urban Weather, Water, Environment and Climate Services (IUS)

1. The Impact of Cities on the Environment

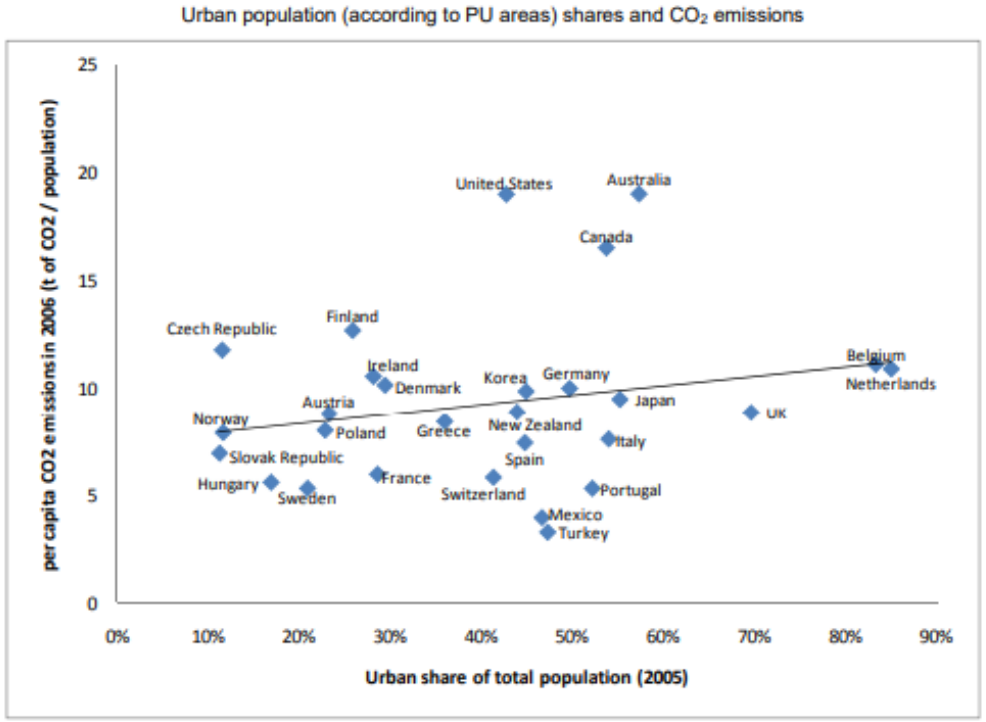
The Environmental Impact of Cities

78% of the world energy is consumed by cities

60% of global CO_2 emissions produced by cities

50% of global waste come from cities

Cities and Greenhouse Gas Emissions

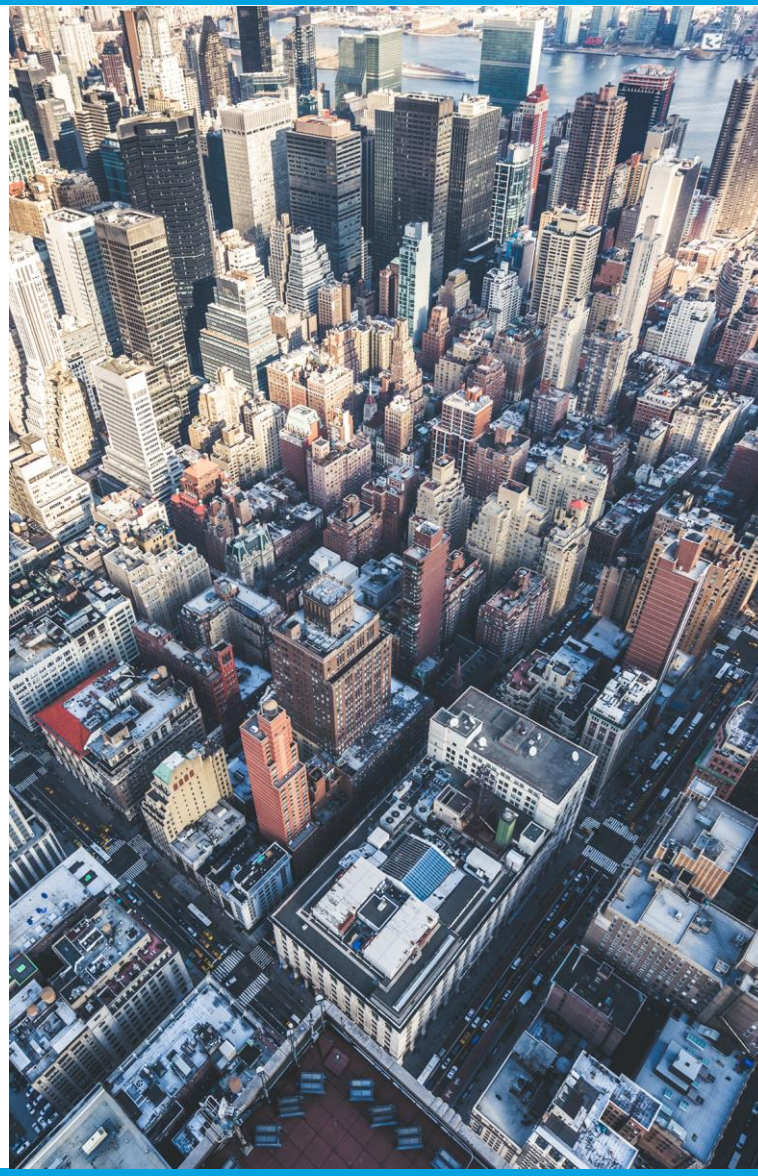


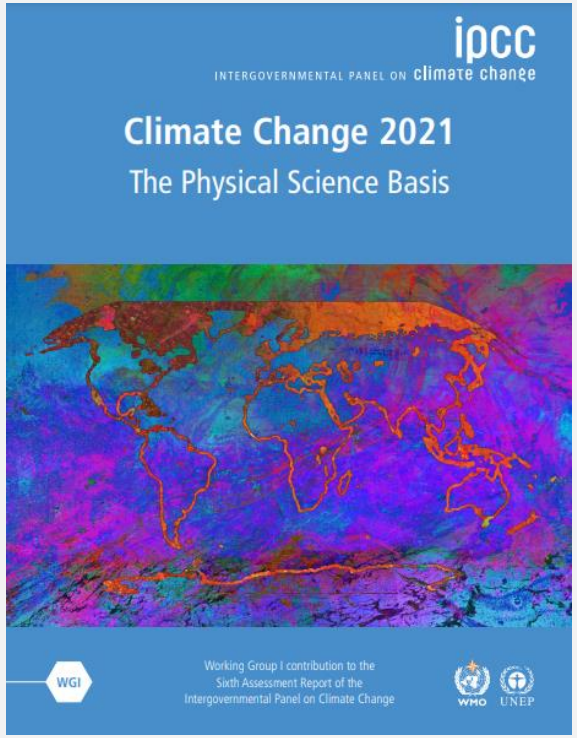
Source: Own calculations based on data from the OECD Regional Database and IEA (2008c), CO2 Emissions from Fuel Combustion, OECD Publishing, Paris.

Cities Growing Impact on the Environment

2021
50% of the population
lives in cities

2050
70% of the population
lives in cities





Direct Impact on the Environment

Cities intensify human-induced **warming** locally, and further urbanization together with **more frequent hot extremes** will **increase** the severity of **heatwaves**.

Urbanization also **increases** mean and **heavy precipitation** over and/or downwind of cities and resulting **runoff intensity**.

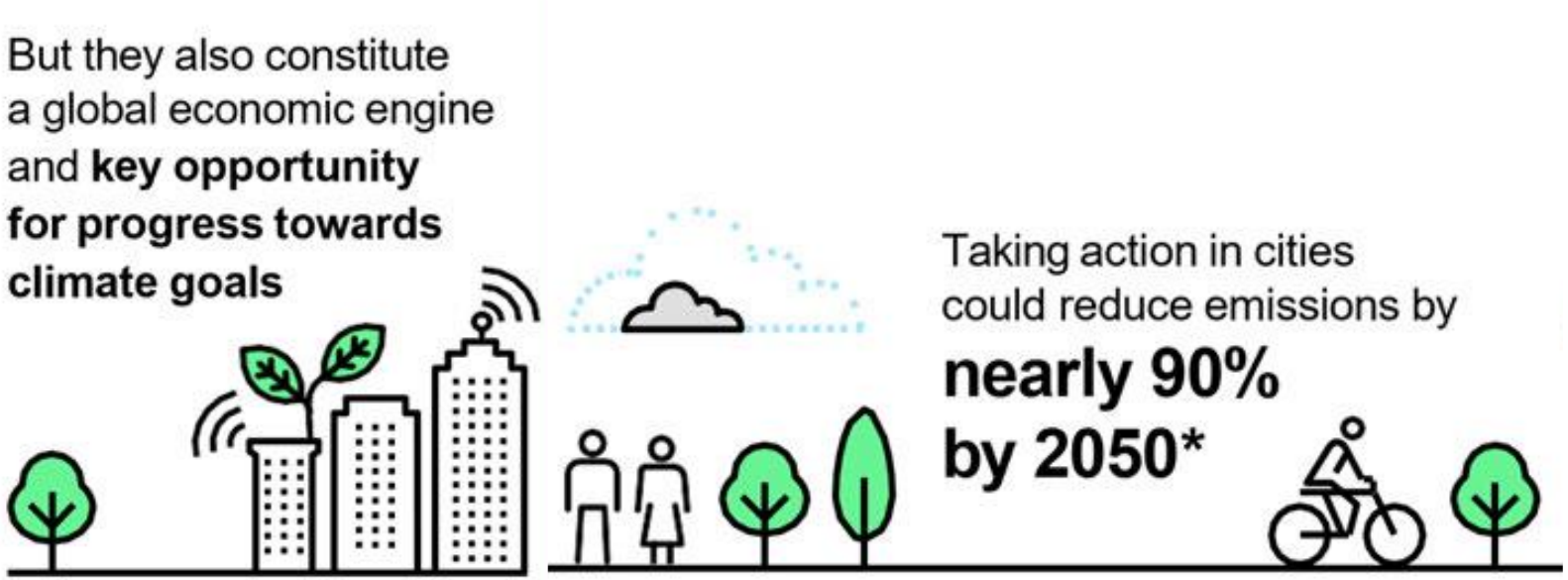
IPCC Climate Change 2021 The Physical Science Basis

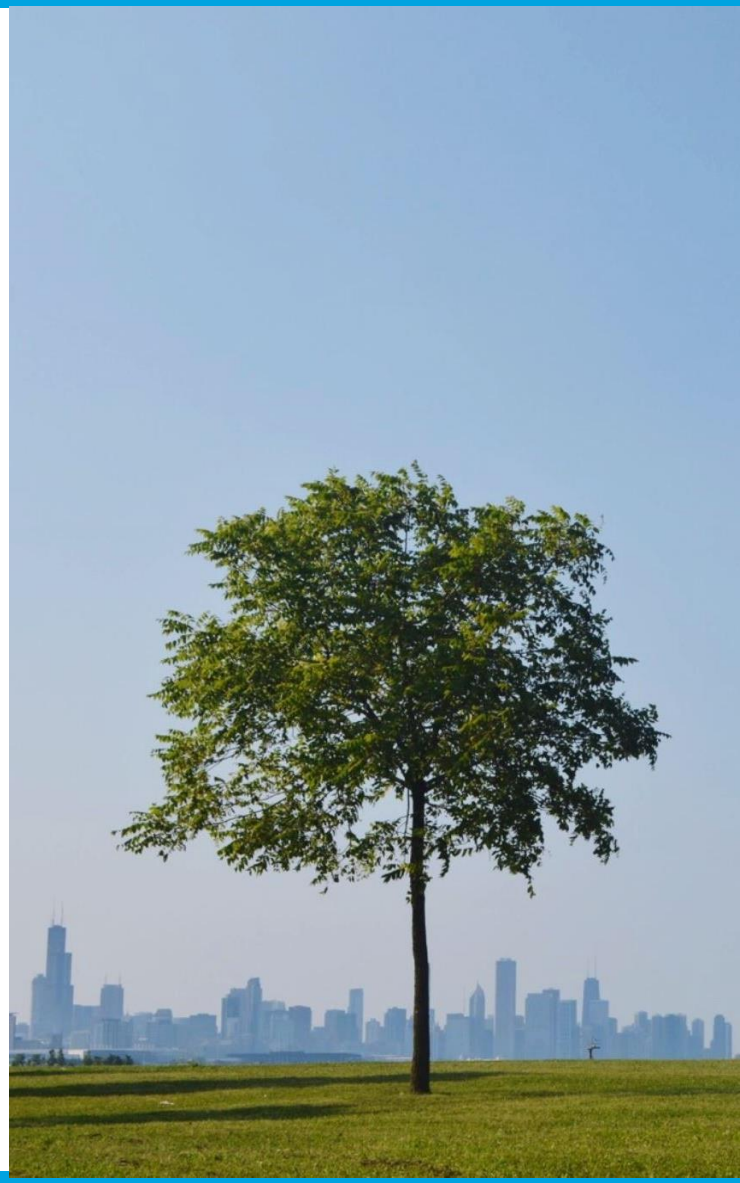
Key Environmental Issues to be Addressed

1. Reducing Traffic and Congestion
2. Increasing Use of Public Transport
3. Reducing the Impact of Buildings
4. Conserving Water Resources
5. Maintaining and Expanding Green Spaces
6. Reducing and Managing Waste
7. Reducing GHG emissions
8. Improving Air Quality

2. Opportunities Using Digital Transformation

Cities Play a Key Role in Addressing Environmental Issues





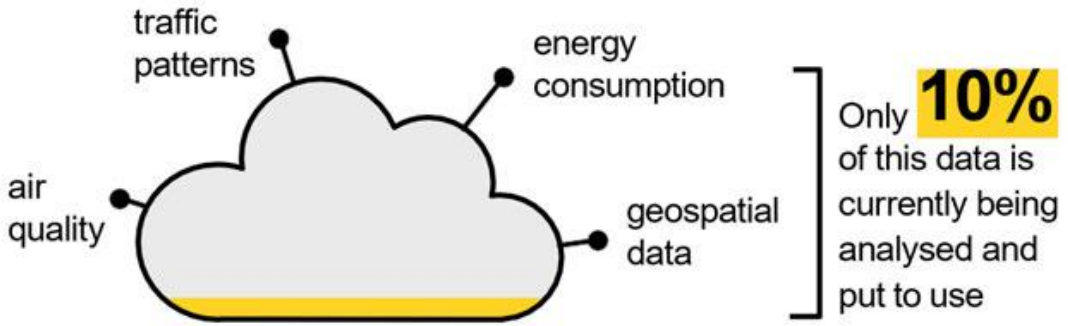
Source : https://www.iea.org/reports/empowering-cities-for-a-net-zero-future

Digital Opportunity in Cities

By **2021:**

83 billion

connected devices and sensors will be creating large, diverse datasets on a wide range of topics:



Only **10%** of this data is currently being analysed and put to use

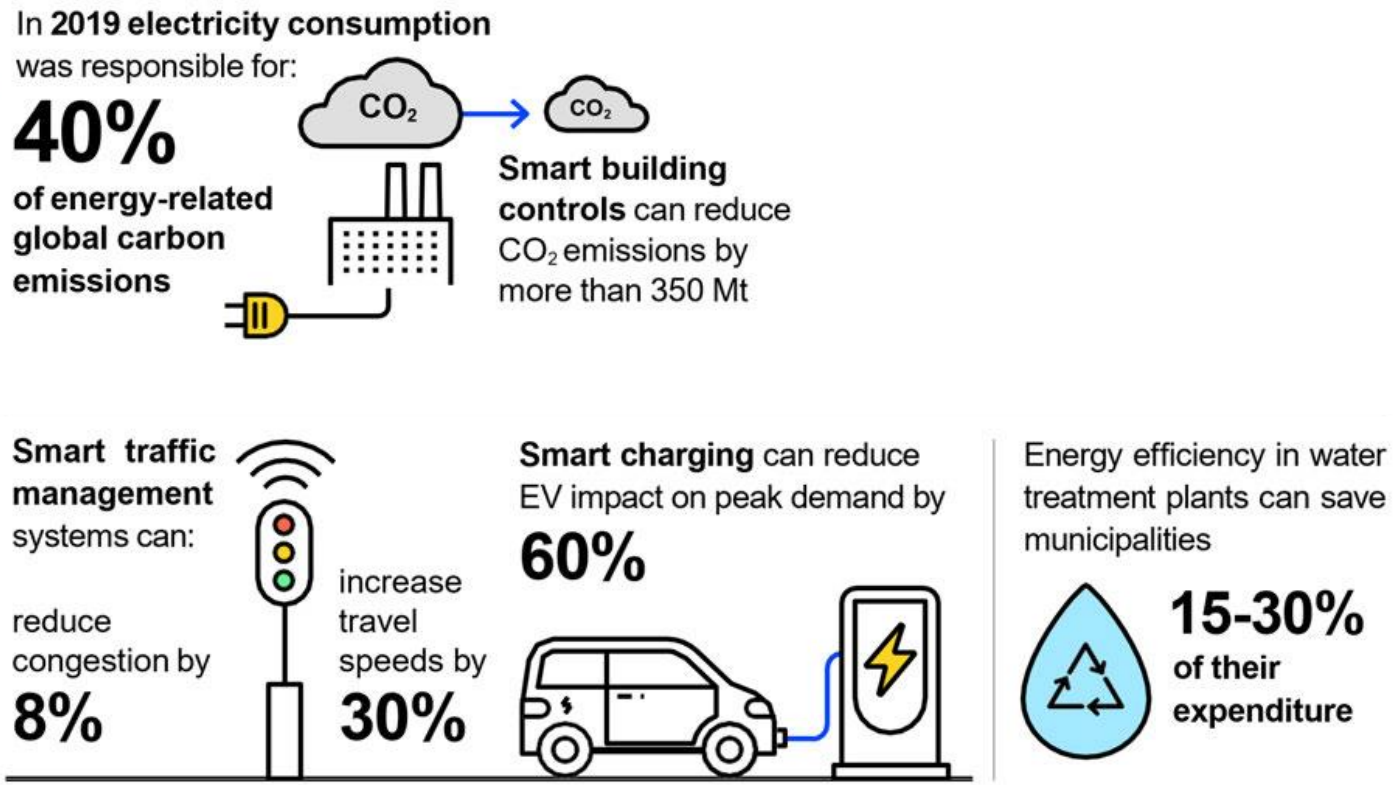
Source : https://www.iea.org/reports/empowering-cities-for-a-net-zero-future

Digital tools can help

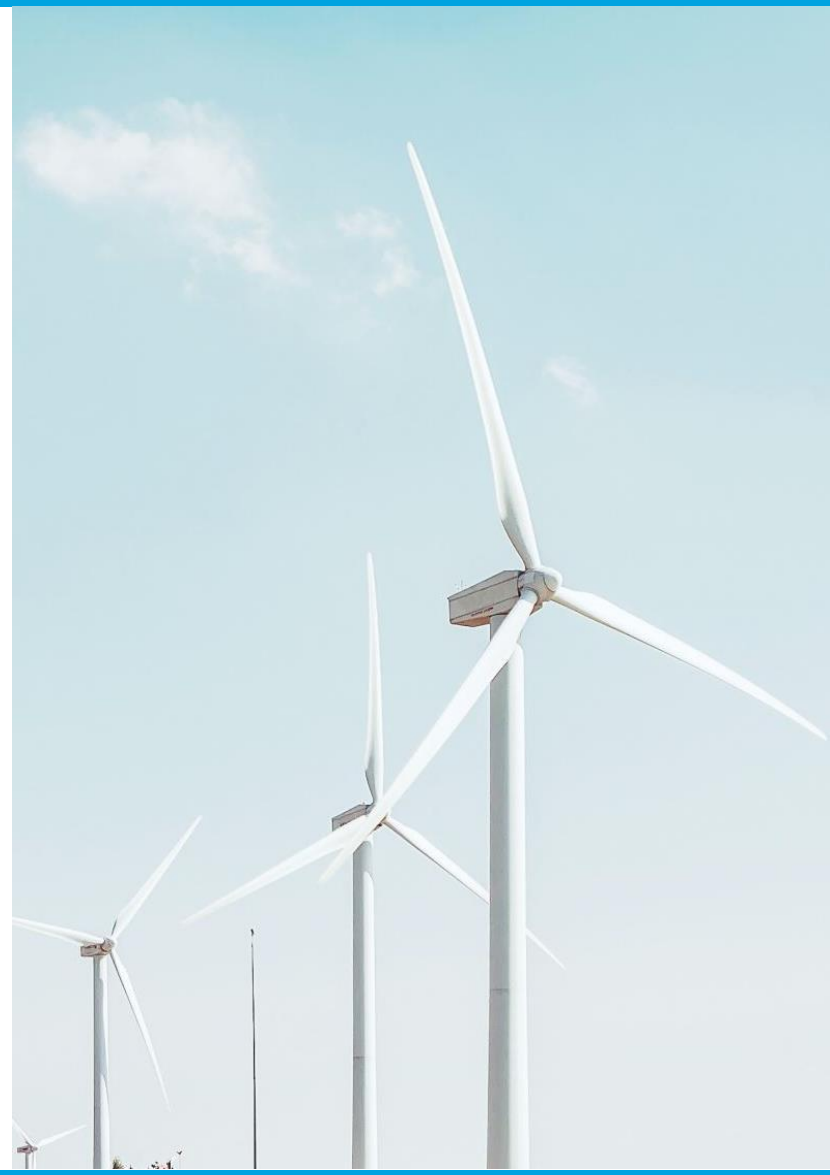
1. Combine and analyze data
2. Provide information and insights
3. Underpin more effective and sustainable policymaking and urban planning
4. Create benefits for citizens

Source : https://www.iea.org/reports/empowering-cities-for-a-net-zero-future

Digital Opportunity in Cities



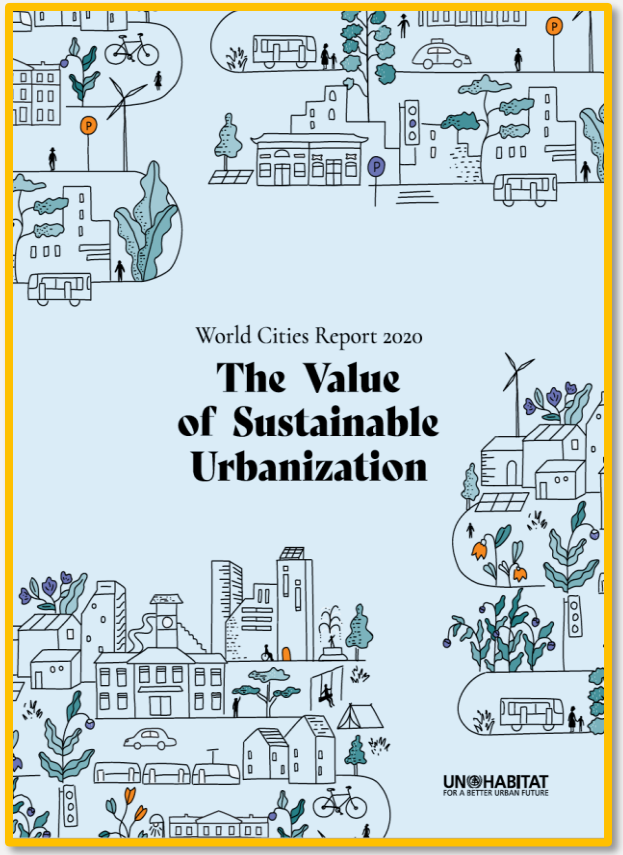
Source : https://www.iea.org/reports/empowering-cities-for-a-net-zero-future



Using Digital Transformation for Sustainable Urbanization

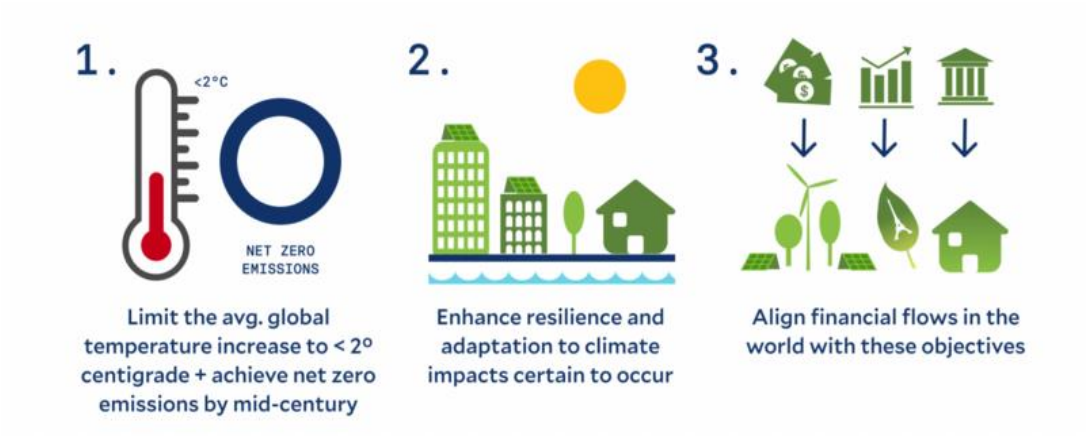
At a time when the world is rapidly urbanizing in the context of serious climate, resource, public health and ecological challenges , the need for innovation broadly understood takes on force.

Besides mobile phones, other kinds of sensors like air or water quality monitoring devices are also becoming less expensive and more widely available, allowing cities and their citizens to monitor environmental conditions more cheaply and frequently.



International Agreements to Support Change

PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21·CMP11



3. Key Tools for Reducing the Environmental Impact of Cities

Introduction to Tools for Reducing the Environmental Impact of Cities

Tool 1
Sustainability Policies and Planning

Tool 2
Key Performance Indicators (KPIs)

Tool 3
Circular Economy

Tool 4
Sustainable Buildings

Tool 5
Intelligent Traffic Management

Tool 6
Smart Water Management

Tool 7
Smart Sewer Management

Tool 8
Digital Twin

Tool 9
Integrated Urban Weather, Water, Environment and Climate Services (IUS)

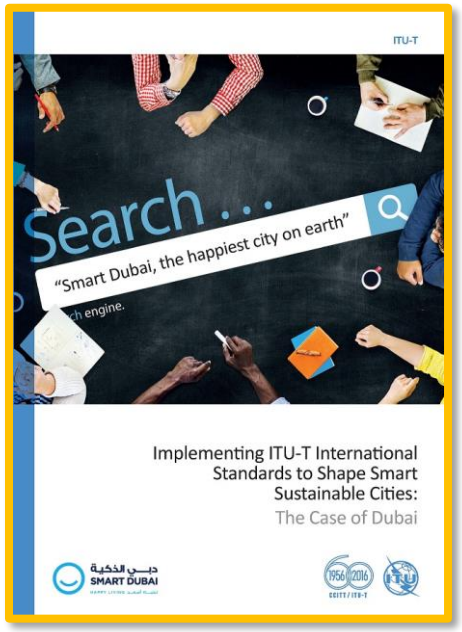
Tool #1

Implementing SDG 11 by connecting sustainability policies and urban-planning practices through digital technologies

Implementing SDG 11 by Connecting Sustainability Policies and Urban-Planning Practices Through ICTs

Policy Guidelines → Planning Actions → Technological Interventions (KPIs & Standards)

Smart Sustainable Cities – ITU Case Studies

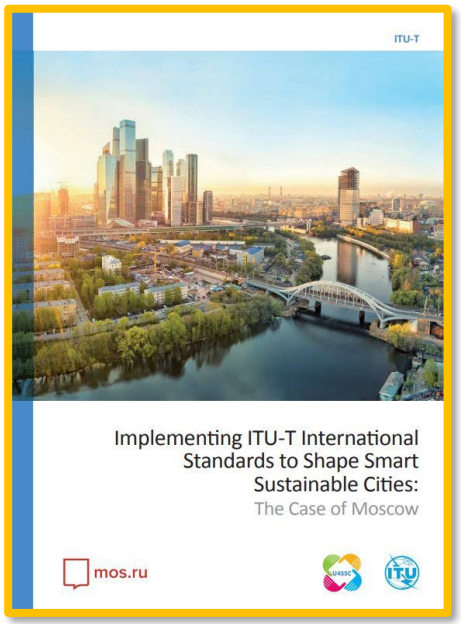


1

Details Dubai's ambitious and trailblazing journey towards becoming a smart sustainable city

2

Elaborates Singapore's journey towards becoming a smart sustainable city.



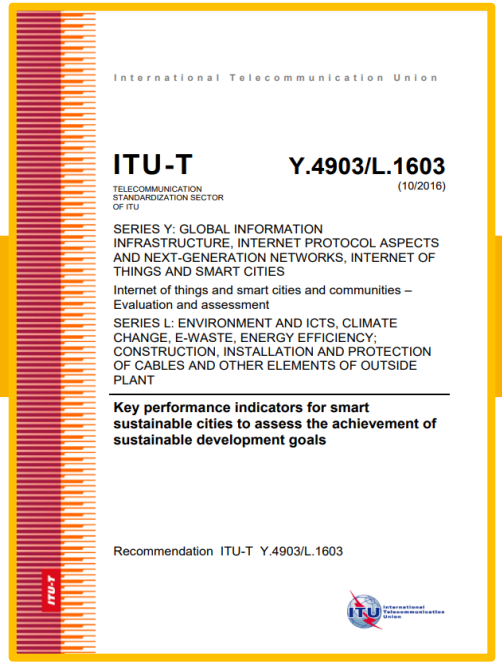
3

Offers practical insights into the experiences of Moscow in transforming into a smart sustainable city

Tool #2

Implementing Key Performance Indicators through the use of U4SSC KPIs

U4SSC Key Performance Indicators


International Telecommunication Union

ITU-T Y.4903/L.1603
(10/2016)

TELECOMMUNICATION STANDARDIZATION SECTOR OF ITU

SERIES Y: GLOBAL INFORMATION INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS AND NEXT-GENERATION NETWORKS, INTERNET OF THINGS AND SMART CITIES

Internet of things and smart cities and communities – Evaluation and assessment

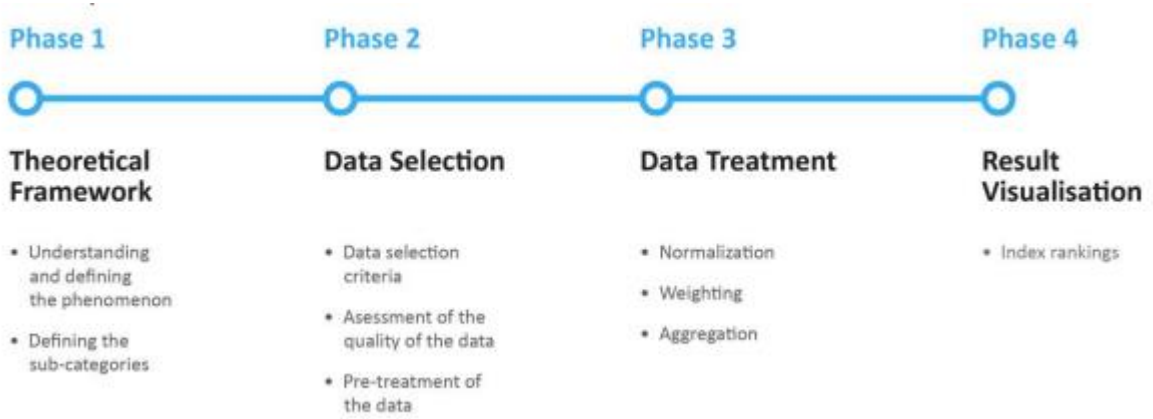
SERIES L: ENVIRONMENT AND ICTS, CLIMATE CHANGE, E-WASTE, ENERGY EFFICIENCY; CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT

Key performance indicators for smart sustainable cities to assess the achievement of sustainable development goals

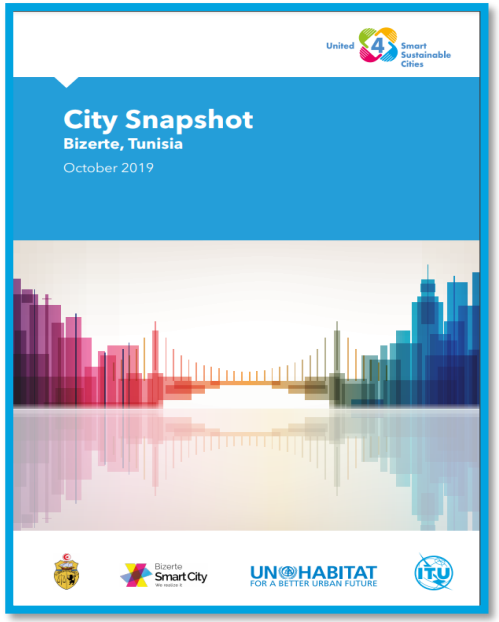
Recommendation ITU-T Y.4903/L.1603

U4SSC Key Performance Indicators

Development and implementation of standards	**ITU-T Study Group 5 on** "Environment, climate change and circular economy" **ITU-T Study Group 20 on** "Internet of things and smart cities and communities"
Research and pre-standartization work	**Focus Group on Data Processing Management (FG-DPM)**
Open platform for knowledge sharing and forward looking research	**United for Smart Sustainable Cities (U4SSC)**
Awareness raising	**Worldwide events**

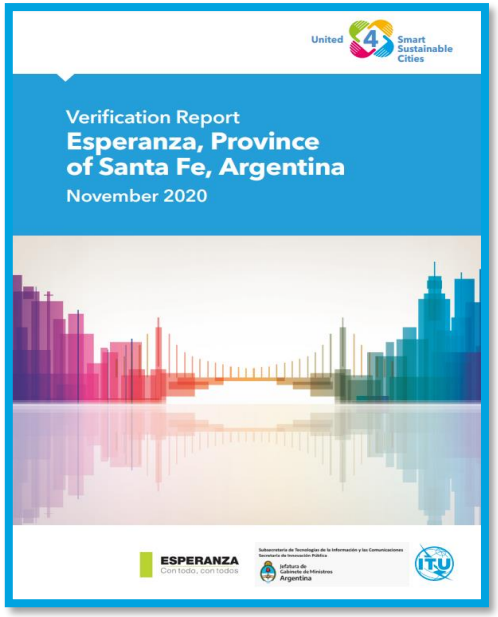


ITU's Implementation of the U4SSC KPIs



City Snapshots

Provide a visual overview of a city's U4SSC KPIs performance based on global benchmarks



Verification Reports

Summarize the conclusions of a city's U4SSC KPIs project

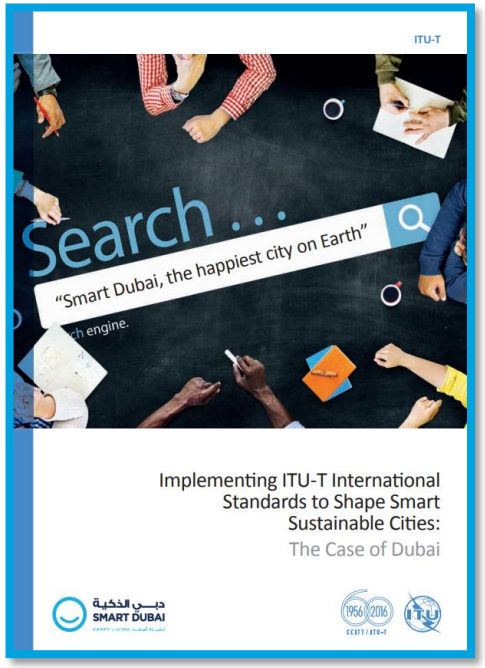
Factsheets

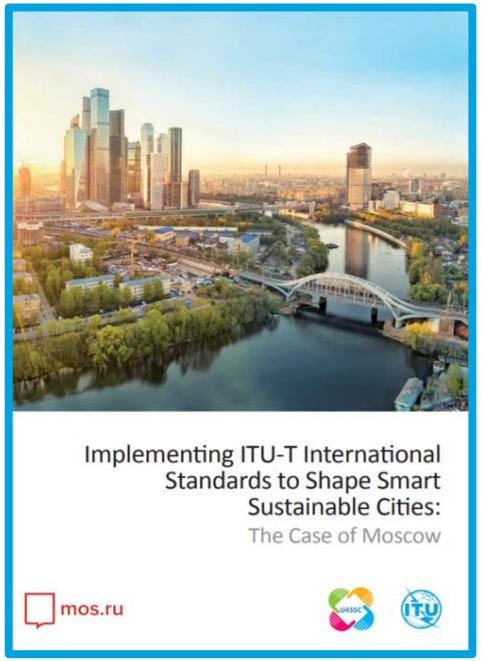
Elaborate and analyze the results of a city's U4SSC KPIs project

List of ITU's Implementation of the U4SSC KPIs available at: https://www.itu.int/en/ITU-T/ssc/united/Pages/publication-U4SSC-KPIs.aspx

ITU's Implementation of the U4SSC KPIs – Case Studies

Detail a city's journey towards becoming a smart sustainable city (SSC)

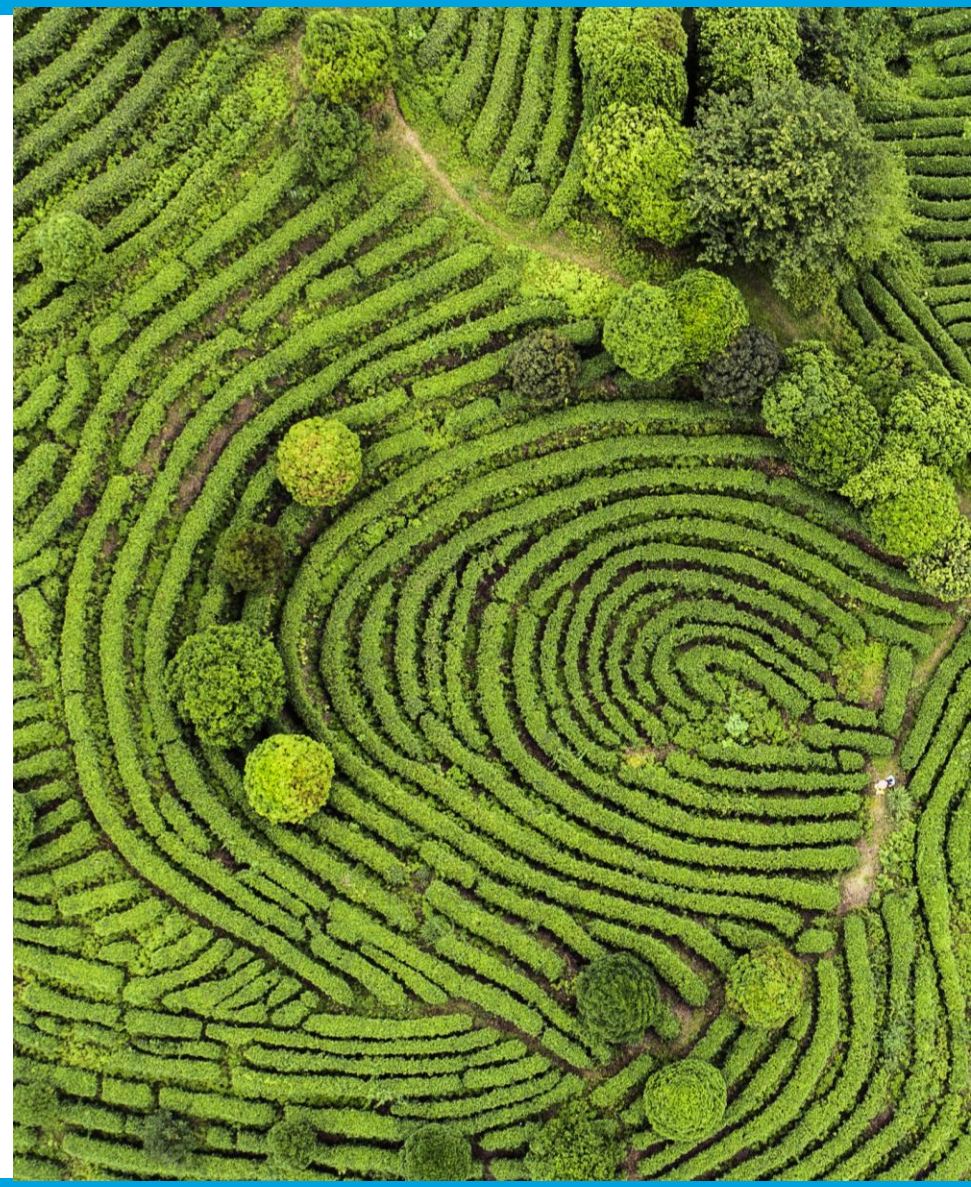




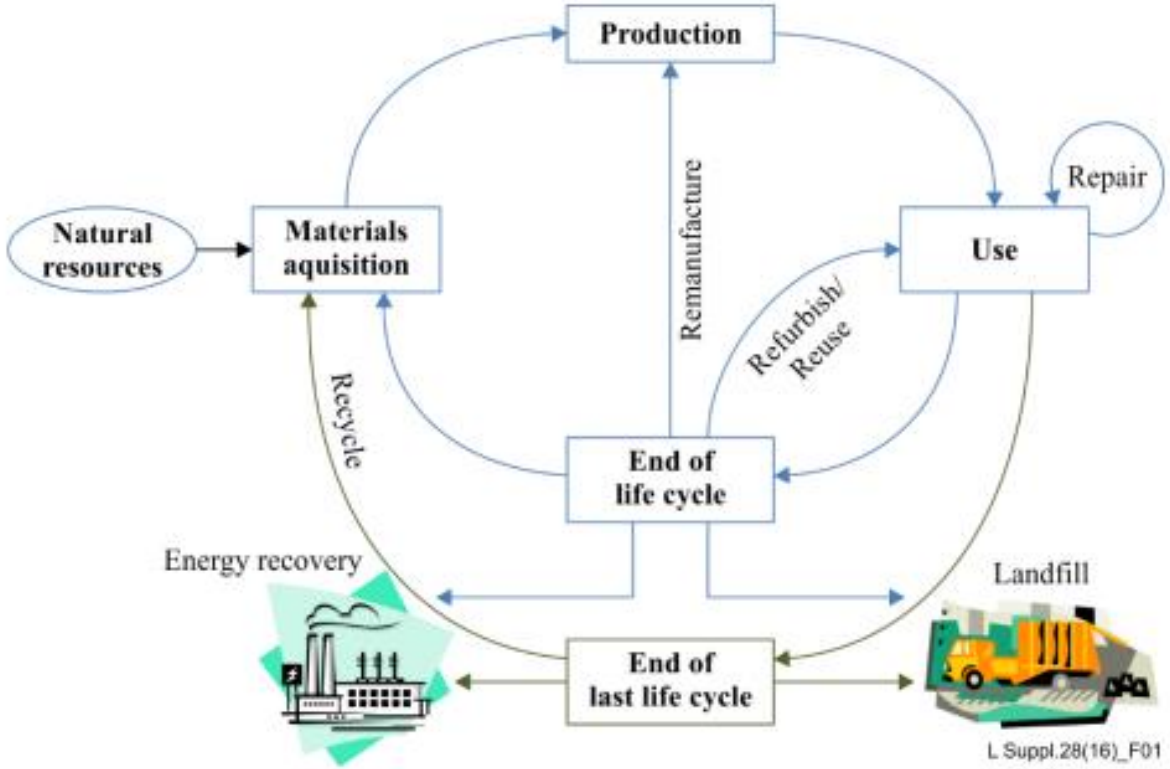
List of ITU's Implementation of the U4SSC KPIs available at: https://www.itu.int/en/ITU-T/ssc/united/Pages/publication-U4SSC-KPIs.aspx

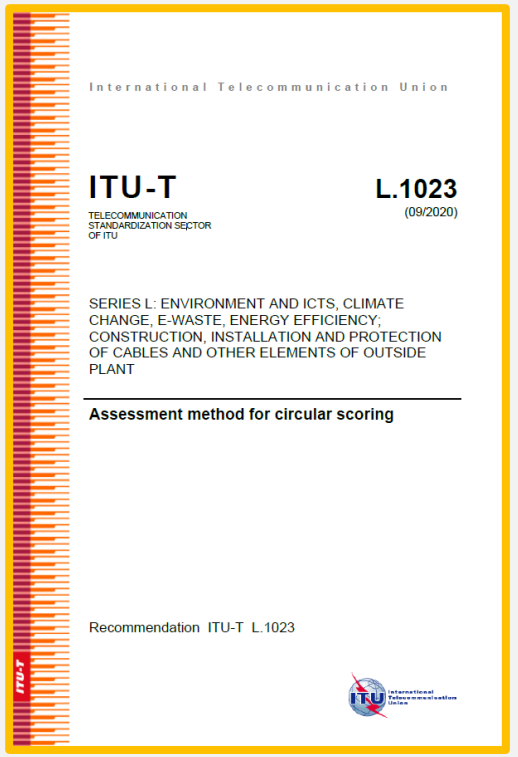
Tool #3

Implementing a Circular Economy



The Circular Economy




International Telecommunication Union

ITU-T
TELECOMMUNICATION STANDARDIZATION SECTOR OF ITU

L.1023
(09/2020)

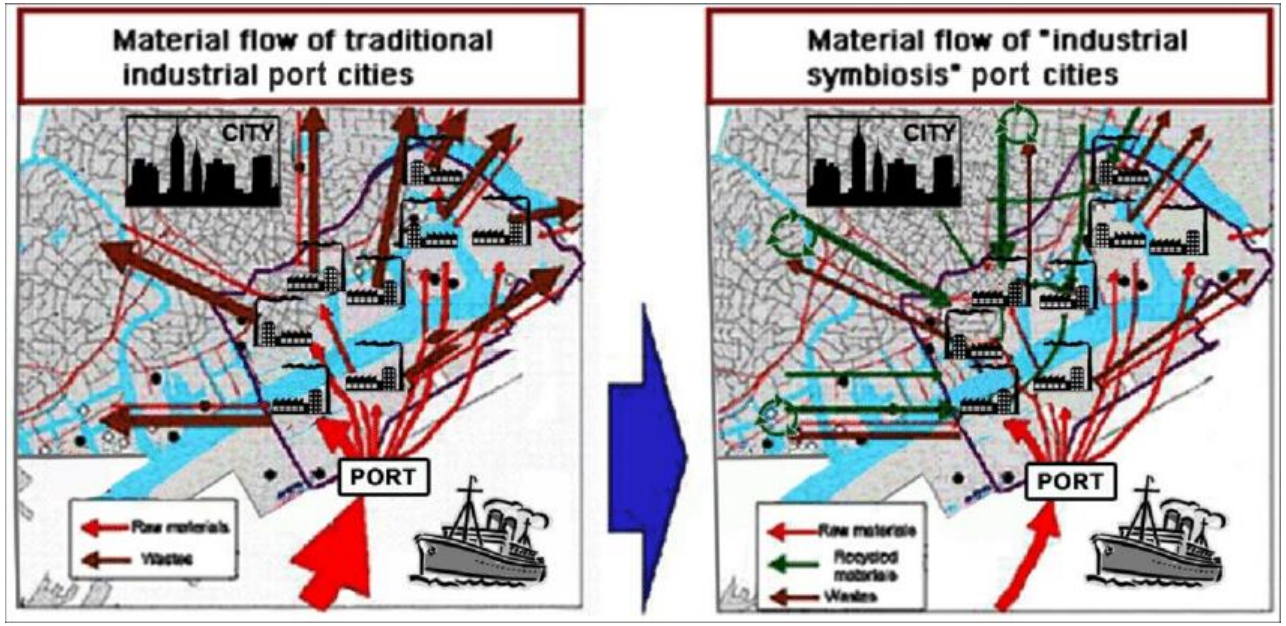
SERIES L: ENVIRONMENT AND ICTS, CLIMATE CHANGE, E-WASTE, ENERGY EFFICIENCY; CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT

Assessment method for circular scoring

Recommendation ITU-T L.1023

Building Circular and Sustainable Cities and Communities

Japanese eco-towns strategy to circularize the industrial city system, with positive outcomes for the environment.



Source: Fusco Girard, Luigi. (2013). Toward a Smart Sustainable Development of Port Cities/Areas: The Role of the “Historic Urban Landscape” Approach. Sustainability. 5. 4329-4348. 10.3390/su5104329.

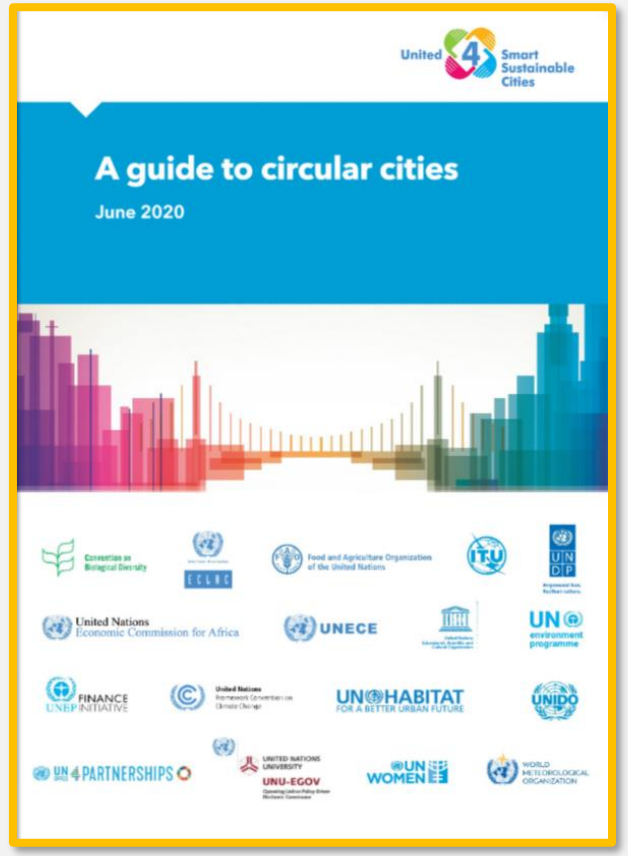
A Guide to Circular Cities

Circular cities and communities:

Utilize assets and resources more efficiently

Produce more sustainably

Apply circular design for large-scale positive impacts



Components of the Circular City Implementation Framework

City assets & products

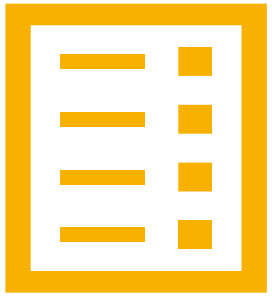
Circular actions

Circular city outputs

Circular city enablers

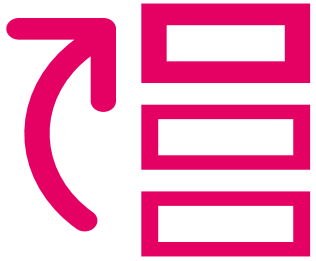
The Four Steps of The Circular City Implementation Framework

1



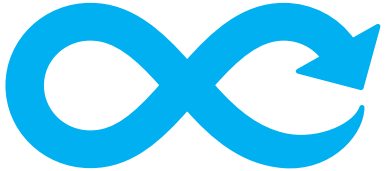
Assessing current circularity

2



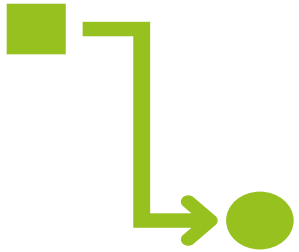
Determining potential for future circularity and prioritizing circularity actions

3



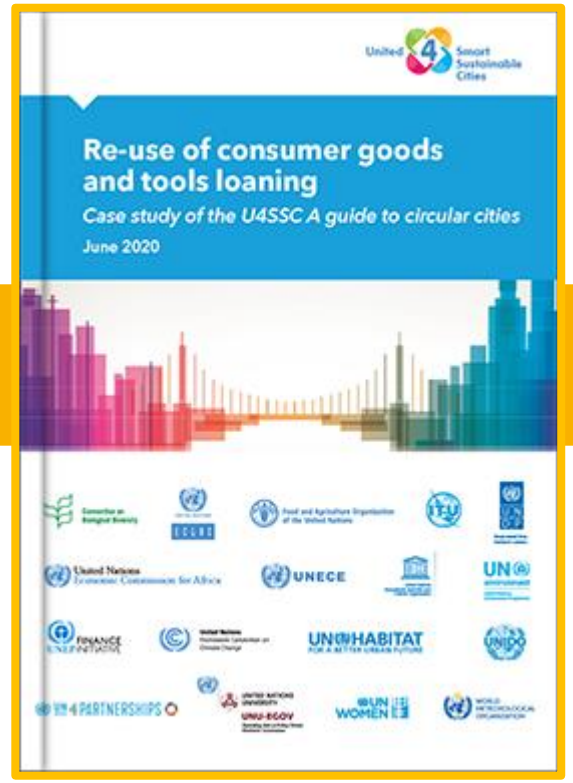
Catalyzing circularity

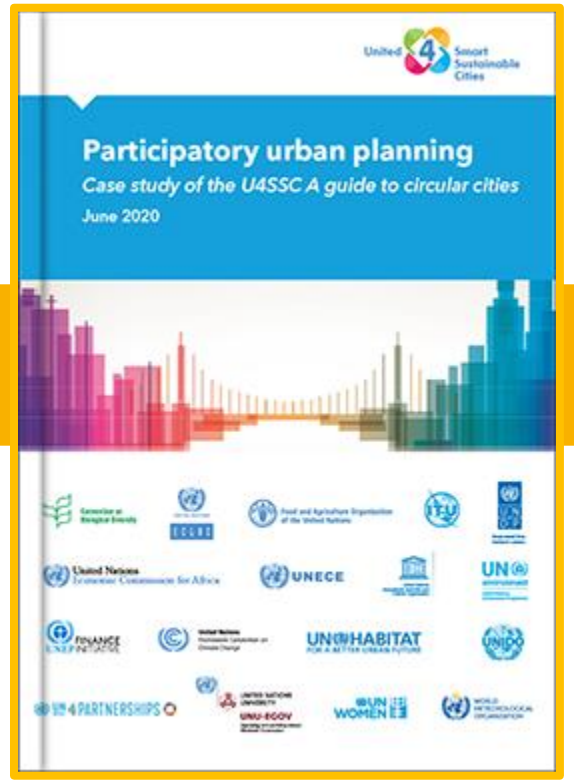
4

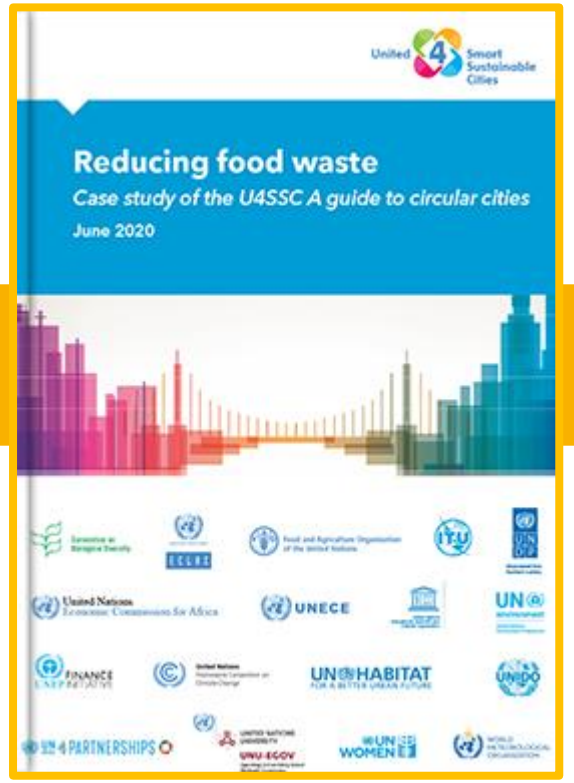


Assessing projected circularity impact

Guide to Circular Cities: Case Studies







Circular Economy : Action Plan

https://ec.europa.eu/environment/strategy/circular-economy-action-plan_en

Tool #4

Smart Buildings Through Digital Transformation

Impact of Buildings on the Environment

32% of total global final energy use

19% of energy-related GHG emissions

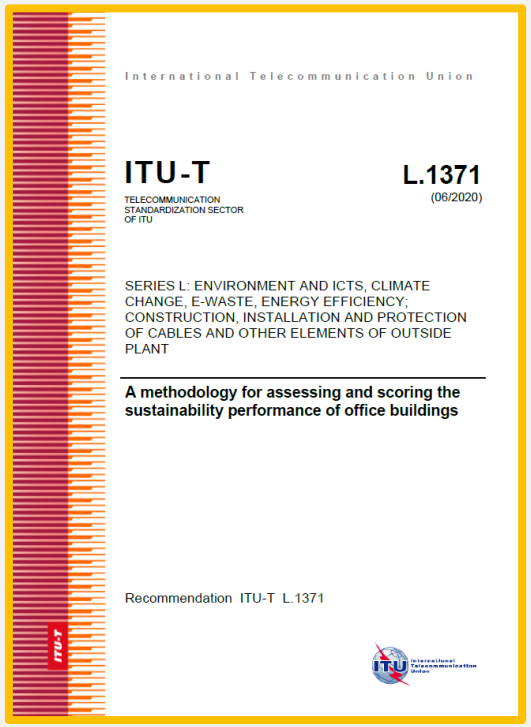
Approx. 1/3 of black carbon emissions

1.8 to 1/3 of F-gasses

Digital Transformation of Buildings

Digitalisation and smart controls can reduce emissions from buildings by 350 Mt CO2 by 2050

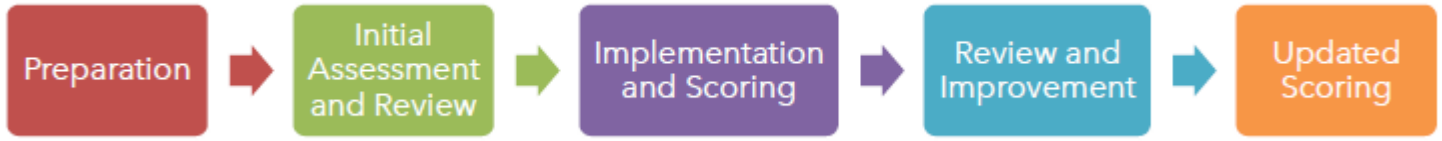
Energy	Water	Air	Comfort	Health and Wellness
Purchasing	Custodial	Waste	Site	Stakeholder Engagement

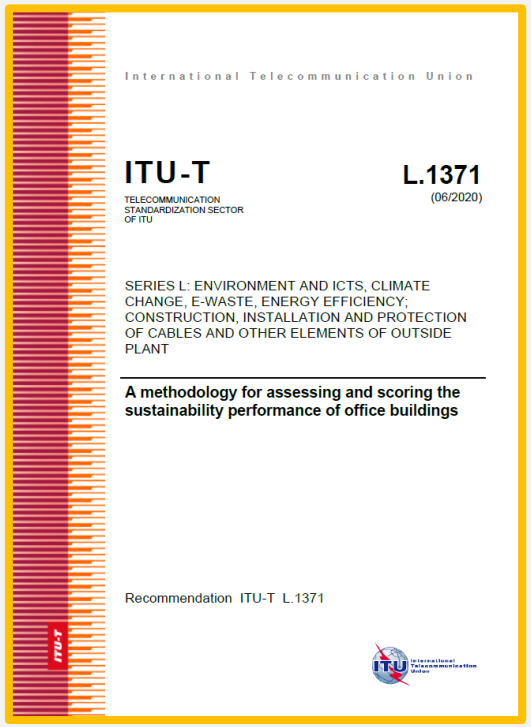


Implementation Steps

Implementing Recommendation ITU-TL.1371 in a building should be a multi-step and multi-stakeholder process to make it most effective.

An action plan should be developed to assign tasks and resources.




International Telecommunication Union

ITU-T
TELECOMMUNICATION STANDARDIZATION SECTOR OF ITU

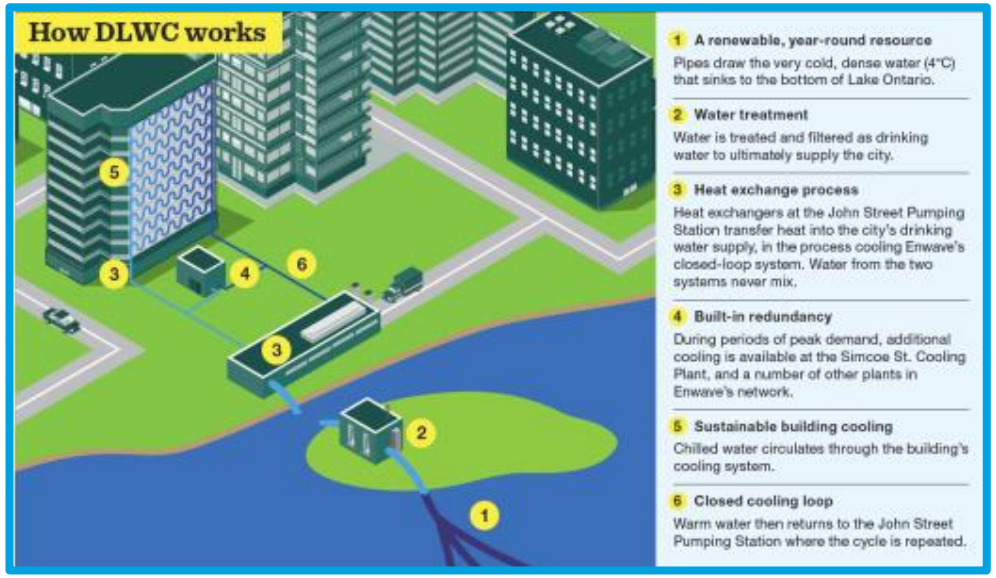
L.1371
(06/2020)

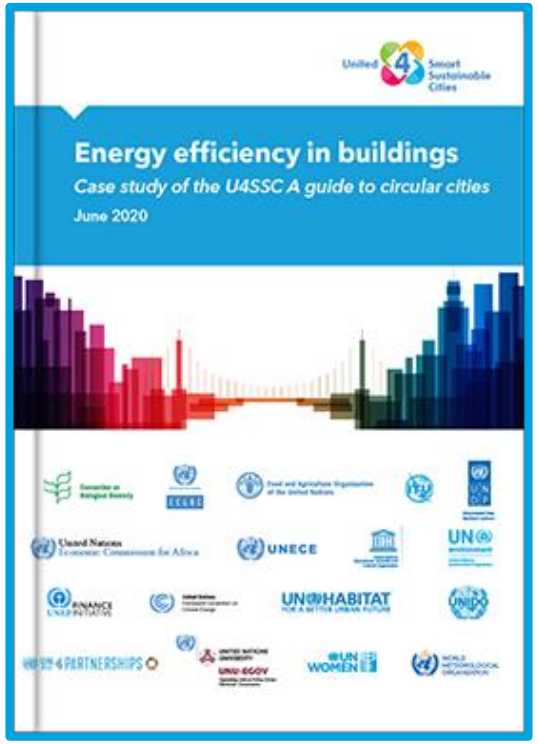
SERIES L: ENVIRONMENT AND ICTS, CLIMATE CHANGE, E-WASTE, ENERGY EFFICIENCY; CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT

A methodology for assessing and scoring the sustainability performance of office buildings

Recommendation ITU-T L.1371

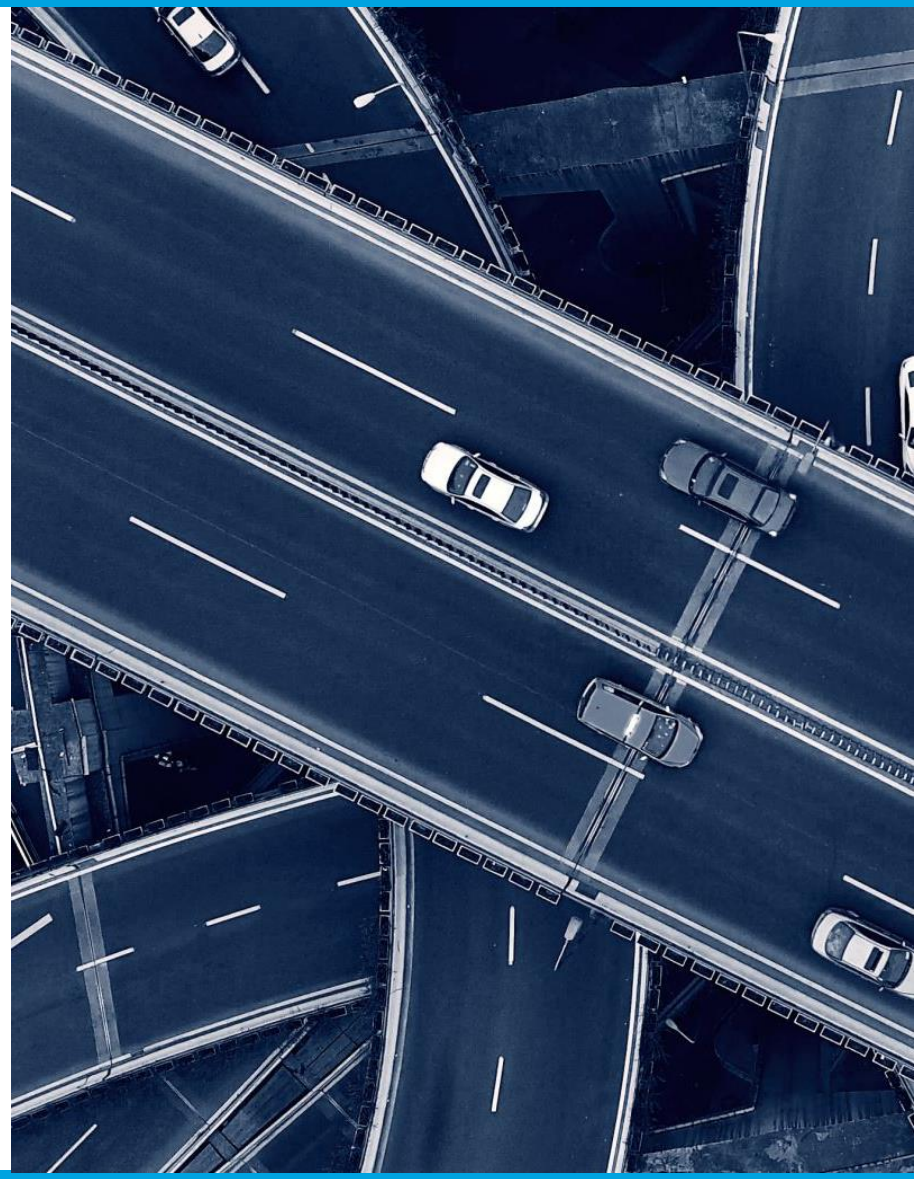
Digital Transformation of Buildings





Tool #5

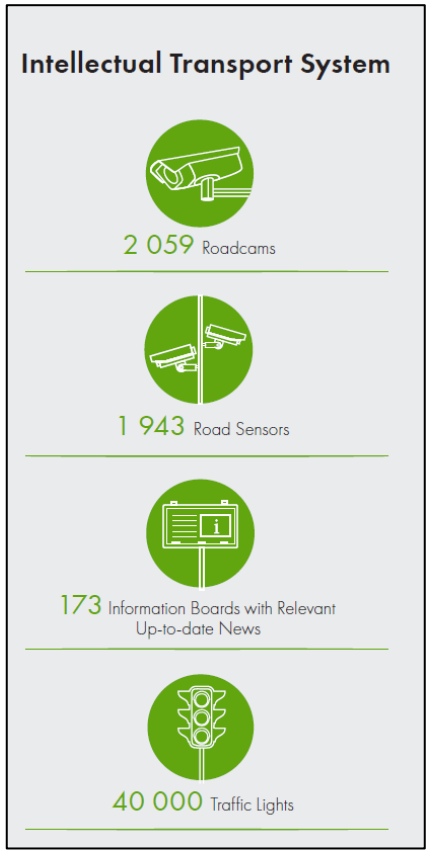
Intelligent Traffic Management

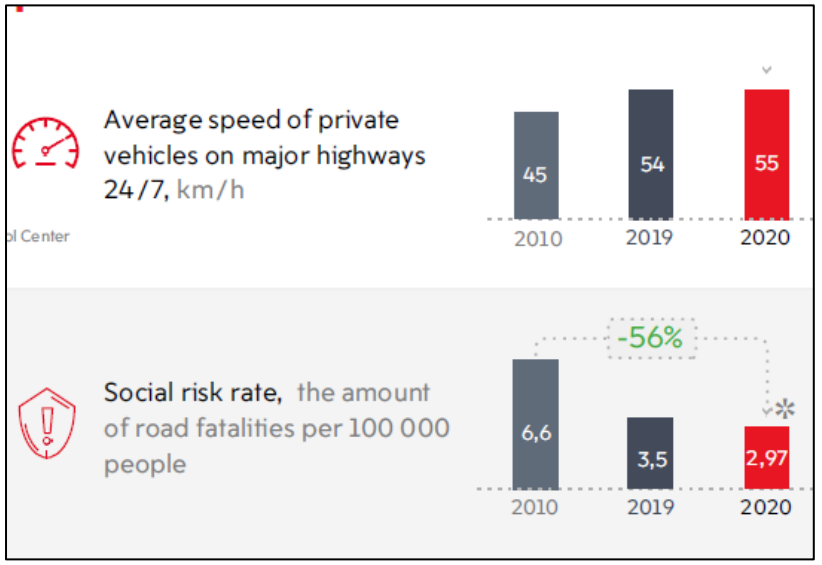


Traffic Congestion Management

There is a direct correlation between traffic volumes and average levels of air pollution, with the prevalence of motor vehicles being a major contributor of air pollution worldwide.

Intelligent Traffic Management - Moscow



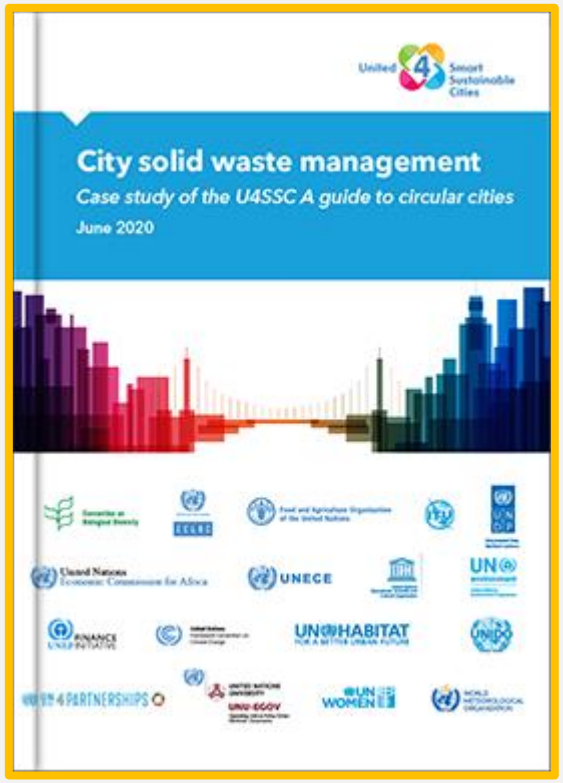


Tool #6

Smart Waste Management

Waste Management in Cities

Cities are responsible for 50 per cent of the waste generated globally and are causing between 60 and 80 per cent of greenhouse gas emissions globally.



Smart Waste Management - Spain

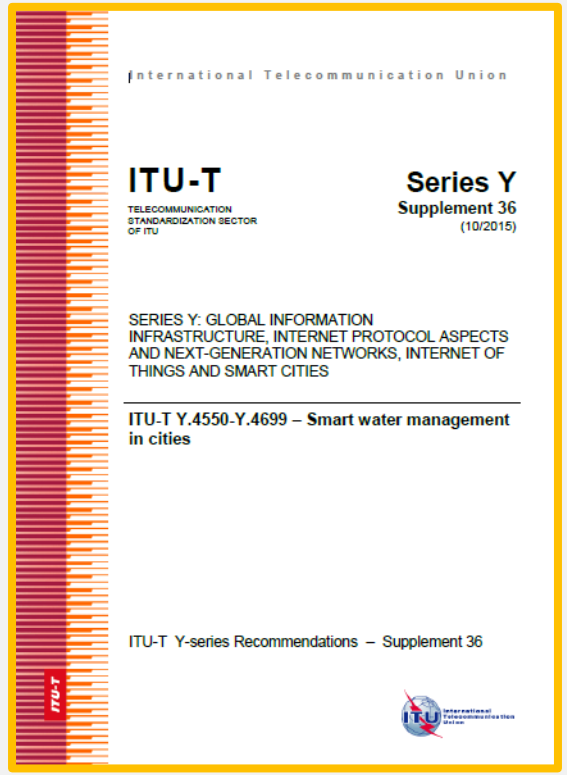
- Increase Recycling
- Implement IoT sensors
- Centralized IoT Platform
- Big Data and AI

Tool #7

Smart Water Management

Smart Water Management

- Economic Savings
- Improved Services
- Improved Wastewater Management
- More Efficient Treatment
- Environmental Protection and Enhancement
- Reduced Carbon Emissions
- Flood Control and Storm Water Management
- Greater Resilience



Smart Sewer Management – Kansas City, USA

- World's largest smart sewer sensor network.

- 300 sensors deployed on the underside of rugged manhole covers
- IoT sensors, as well as AI and deep data-sets, for controlling sewer and stormwater flows.

- Sensors act as a type of flowmeter like sonar, measuring the flow and depth of the water in any given spot

- Real-time decision support system to dynamically control the flow of water to help prevent combined sewage from entering the Missouri River

- In-line gates to maximize storage in the sewer system during heavy rains, much the same as smart traffic lights work during rush hour

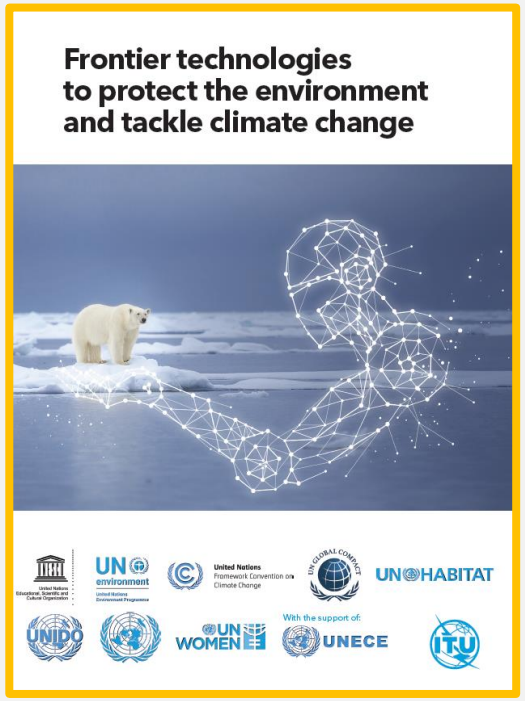
Source: https://www.smartcitiesworld.net/special-reports/special-reports/smart-sewers-smart-cities-start-eight-feet-below-the-ground

Tool #8

Digital Twin for Cities

Digital Twin for Cities

1. Improve Operational Efficiency
2. Optimize Energy Consumption
3. Enhance Disaster Preparation
4. Improve Mobility and Transportation
5. Improve Urban Design
6. Increase Measuring and Monitoring

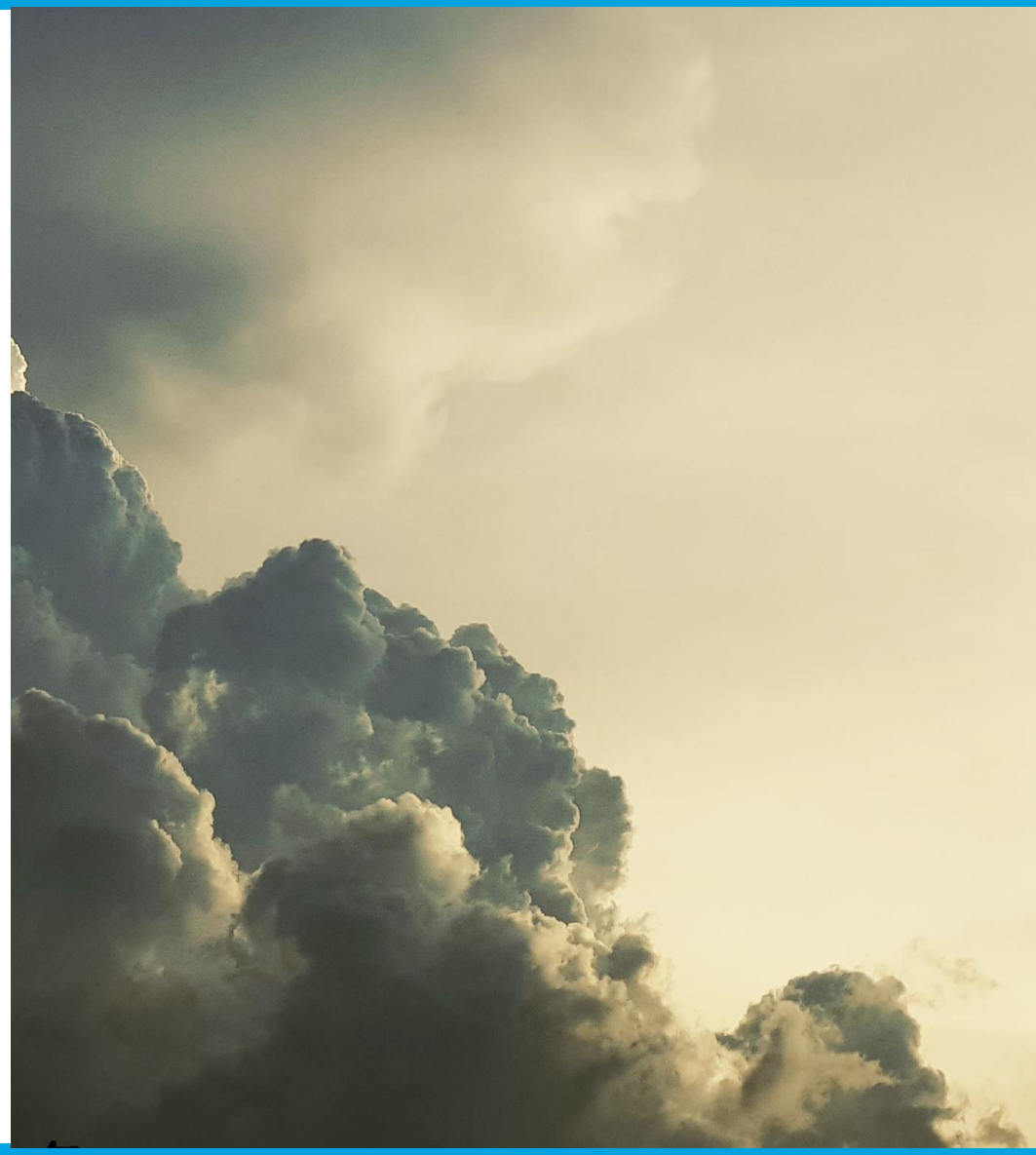


Digital Twins for Extreme Weather Events – Newcastle, UK

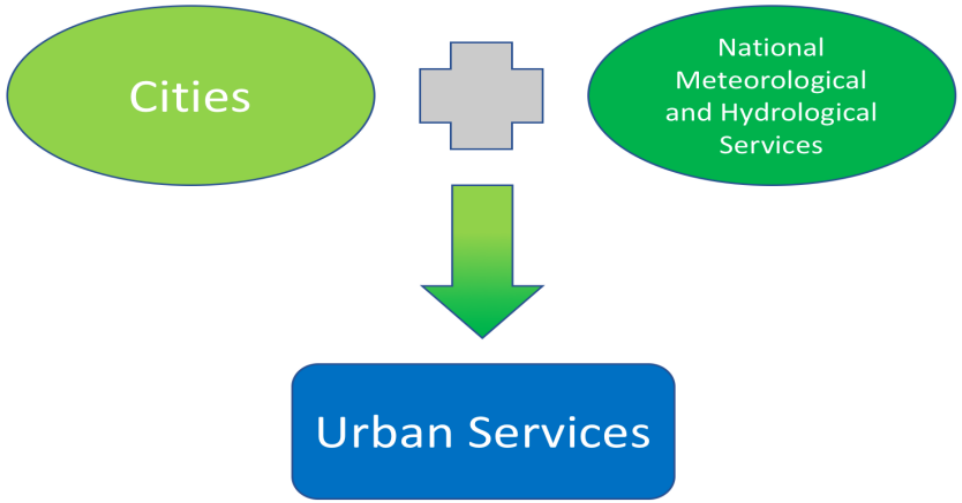
- Extreme rainstorm in 2012 - ‘Toon Monsoon’.
- One month of rain in 2 hours
- Drainage systems were overwhelmed
- £8 million worth of damage
- Build a digital twin to model scenarios to determine the impact of climate change

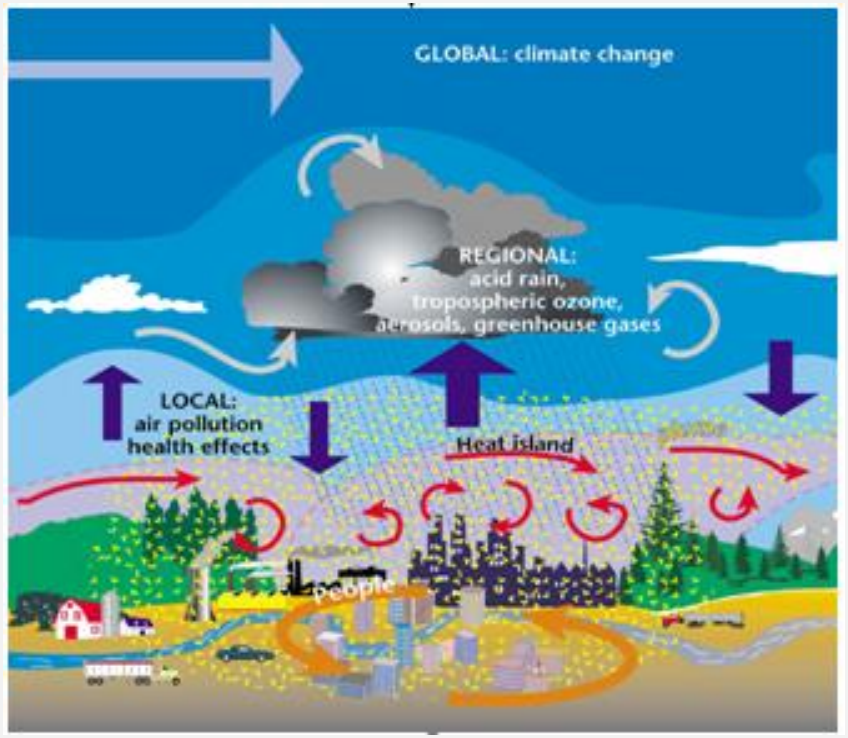
Tool #9

Integrated Urban Weather, Water, Environment and Climate Services (IUS)



Statement of the Problem





Hazards and Risks in the Urban Environment

Hazards and Risks in the Urban Environment

1. Resiliency through Multi-Hazard Early Warning Systems
2. Sustainability through urban long term planning
3. Capability and capacity through cross-cutting services
4. Efficiency through infrastructure cross-cutting services
5. Consistency (hence, effective and efficient) through integration
6. Effective service through Partnerships / Risk Communication

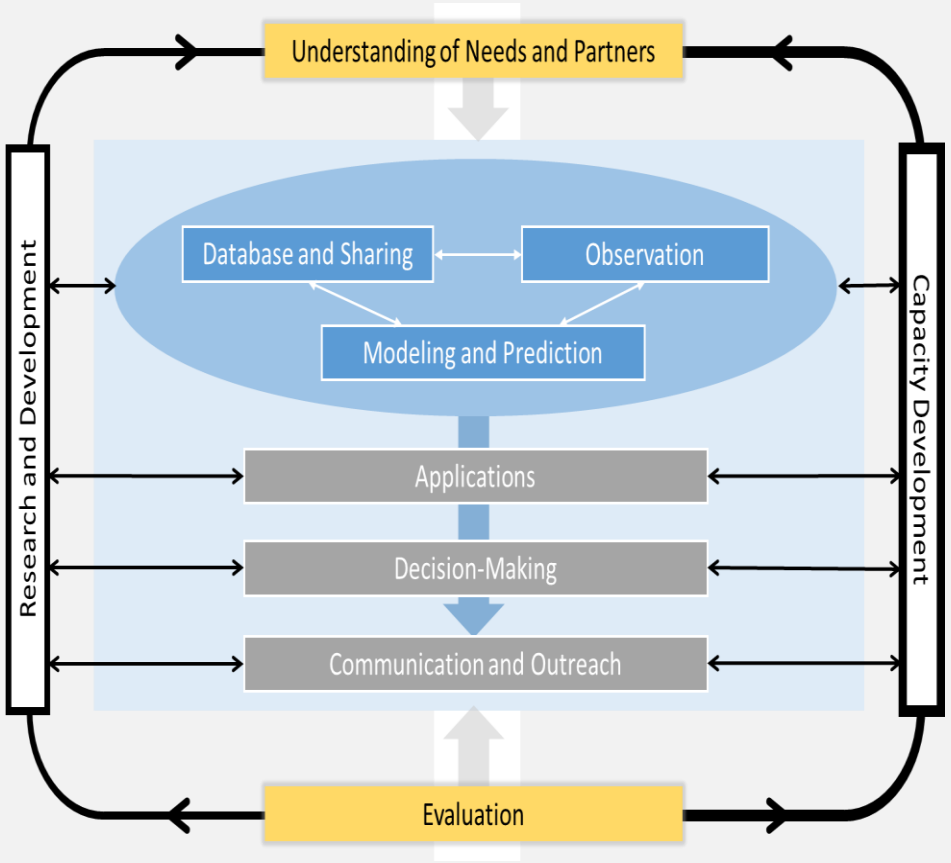
Components of the development an Integrated Urban Weather, Environment and Climate Service (IUS)

Weather

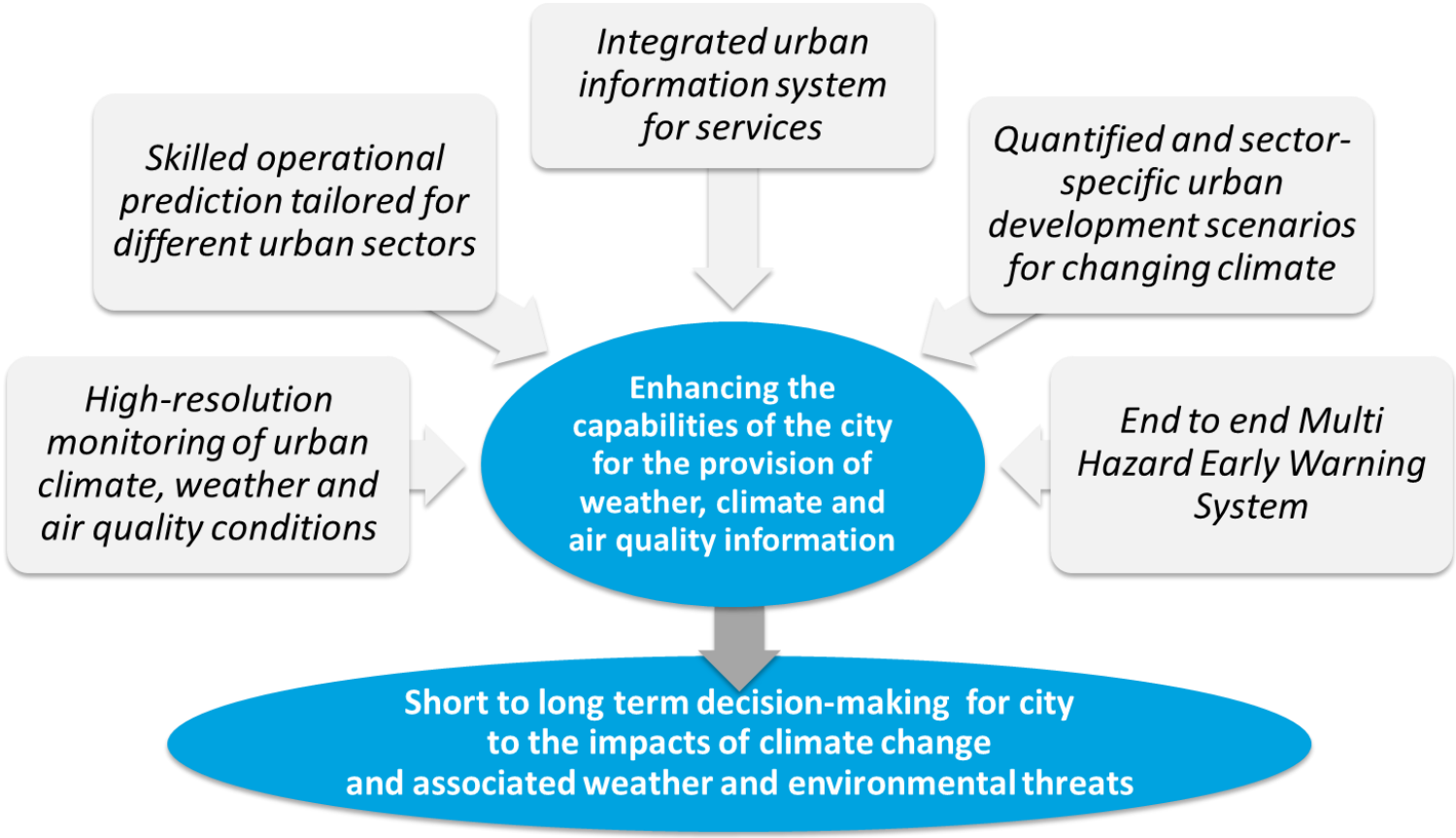
Climate

Hydrology

Air Quality

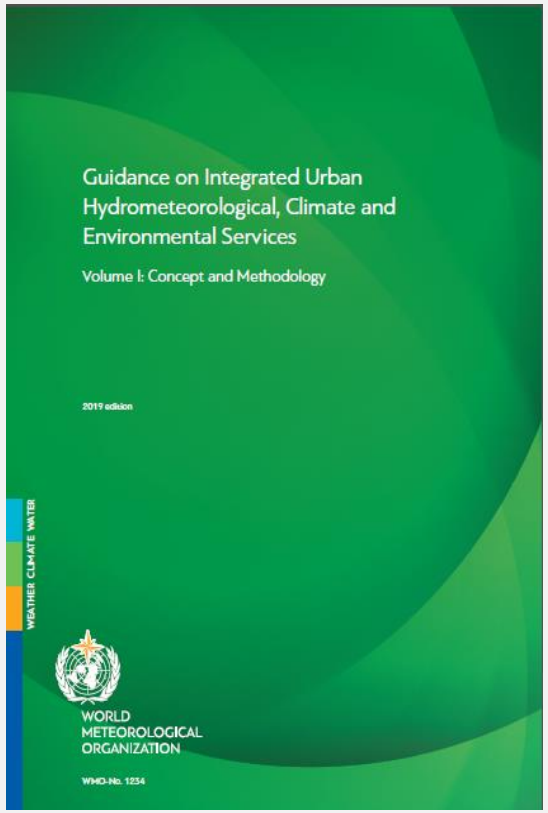


Actions for IUS Development

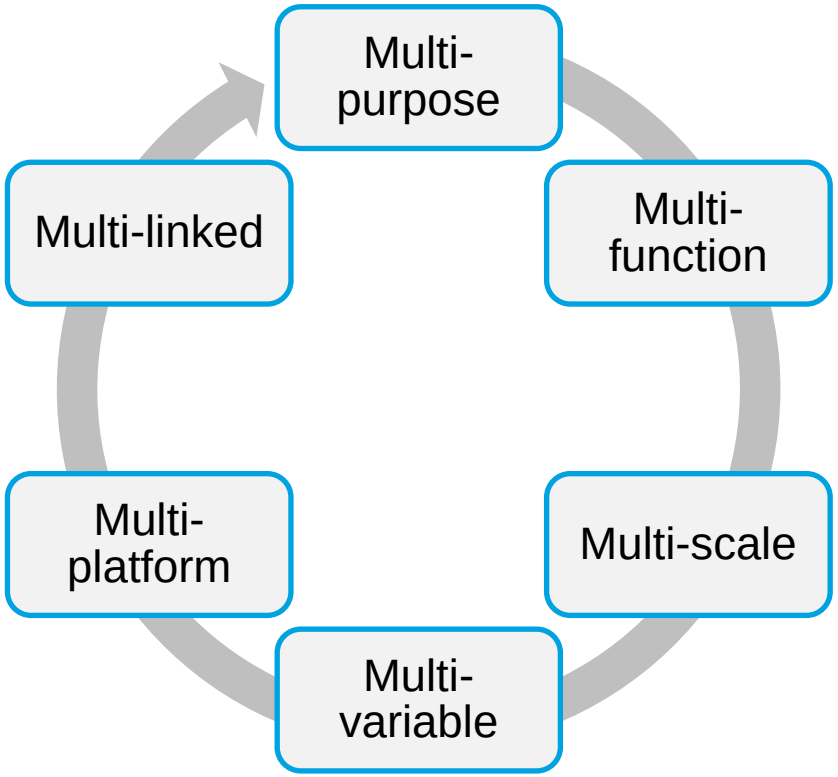


Guidance on Integrated Urban Hydro-Meteorological, Climate and Environmental Services (IUS)

To document and share the ***best available practices*** that will allow Members to ***improve the resilience of urban areas to a great variety of natural and other hazards***



Translating Research to Improved Urban Services



Case Study: Hong Kong Local Experiences on IUS

Extreme Weather Events (HKO)
- Tropical cyclone and storm surge
- Thunderstorm and lightning
- Rainstorm, flooding and landslide
- Extreme hot & cold weather events
- Drought

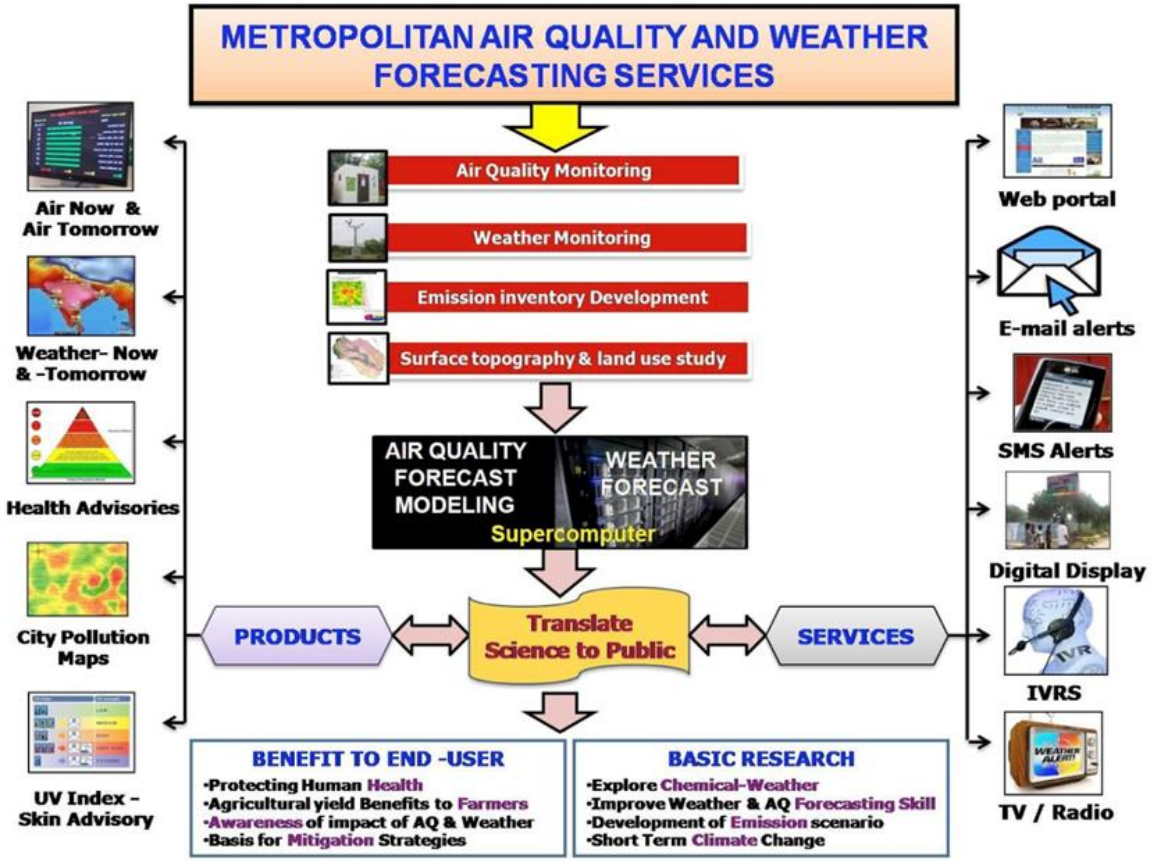
Air quality modeling and forecast (EPD)
- Air Quality Health Index

Utilization of climate information (HKO)
- Climate change
- Disaster risk reduction (DRR)
- Urban climate evaluation

Evaluation
(Some examples)
- Wind load on buildings and infrastructures
- Coastal structure design
- Drainage system and slope safety
- Lightning safety
- Thermal comfort and health impact
- Energy demand / saving
- Water resources
- High air pollution area detection
- City resilience and disaster preparedness
- Urban heat island
- Air Ventilation Assessment (AVA)

Examples of Urban Planning & Infrastructure Construction
- Design standard and code of practices for buildings and infrastructures (e.g. "Building Wind Code", Drainage Master Plan, Port Work Design Manual, etc.)
- Mitigation measures to natural terrain landslides
- Drainage tunnels and Underground Stormwater Storage Tanks
- Blue-Green infrastructure
- Total water management strategy
- Climate change mitigation and adaptation measures
- Road networking design and urban density control
- Implementation of AVA and Urban Climatic Map into planning of new development and old district renewal

Lessons Learned



Module 6 –
Digital Transformation to Reduce the Environmental Impact of Cities

Thank you for completing this Module of the ITU Toolkit on Digital Transformation for People-Oriented Cities and Communities.

We hope that you found the information in this Module useful toward planning and initiating your city or community's digital transformation process.

Please review the resources highlighted within for further details, including valuable real-world use cases, on how to get started on – and optimize from the onset – your city or community's digital transformation journey.

Toolkit on Digital Transformation for People-Oriented Cities and Communities

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