



Urban Environment

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What to expect?

- ❖ Key concepts in sustainable urban environment and urban environment management.
- ❖ Key considerations for integrating sound and sustainable urban environmental solutions in city climate change action plans
 - ☐ Ecosystem and Biodiversity
 - ☐ Green Infrastructure
 - ☐ City as a System
 - ☐ Renewable energy
 - ☐ Green Space
 - ☐ Co-benefits



ECOSYSTEM & BIODIVERSITY

What is an ecosystem?

- A community of all the living things in an area and the way they affect each other and its non-living structure in the environment
- Types of ecosystems:
 - Terrestrial vs Aquatic
 - Natural vs Artificial
 - Macro and micro

Types of Ecosystem with Examples

I: Natural: Terrestrial



Grassland



Forest



Desert

Natural: Aquatic

www.plantscience4u.com



a) Marine: Oceans



b) Freshwater: Lakes

II: Artificial or Manmade

Aquarium




















Crop field



Ecosystem services



Provisioning services	Regulating services		Habitat/supporting services	Cultural services
 Food	 Local climate and air quality	 Carbon sequestration and storage	 Habitats for species	 Recreation and mental/physical health
 Raw materials	 Moderation of extreme events	 Wastewater treatment	 Maintenance of genetic diversity	 Tourism
 Fresh water	 Erosion prevention	 Pollination		 Inspiration for culture, art and design
 Medicinal res.	 Biological control		<p><i>Source: TEEB, 2017</i></p>	 Spiritual experience and sense of place

Ecosystem services, biodiversity: are they indefinite resources?

- A **healthy ecosystem** is one that is **sustainable** – that is, it has the ability to maintain its structure (organization) and function (vigor) over time in the face of external stress (resilience). (*Costanza and Mageau, 1999*)
- **Ecosystem/Planetary boundaries**

<http://www.stockholmresilience.org/>

Sustainability

Organization	<ul style="list-style-type: none">• Species• Non-living structures
Vigor (function)	<ul style="list-style-type: none">• Internal• External
Resilience (Ability to recover from external stress)	<ul style="list-style-type: none">• Shocks• Gradual changes

Ecosystem services, biodiversity and city: the case of Istanbul

(B. Güneralp et al., 2013)

- Over 13 million population
- Fast population growth (esply since 1980)
- Biggest metropolitan area of Turkey and hub of economic and political activities
- Long history and a world heritage site
- Rich biodiversity
- Diverse micro-climatic zones
- Large bodies of water

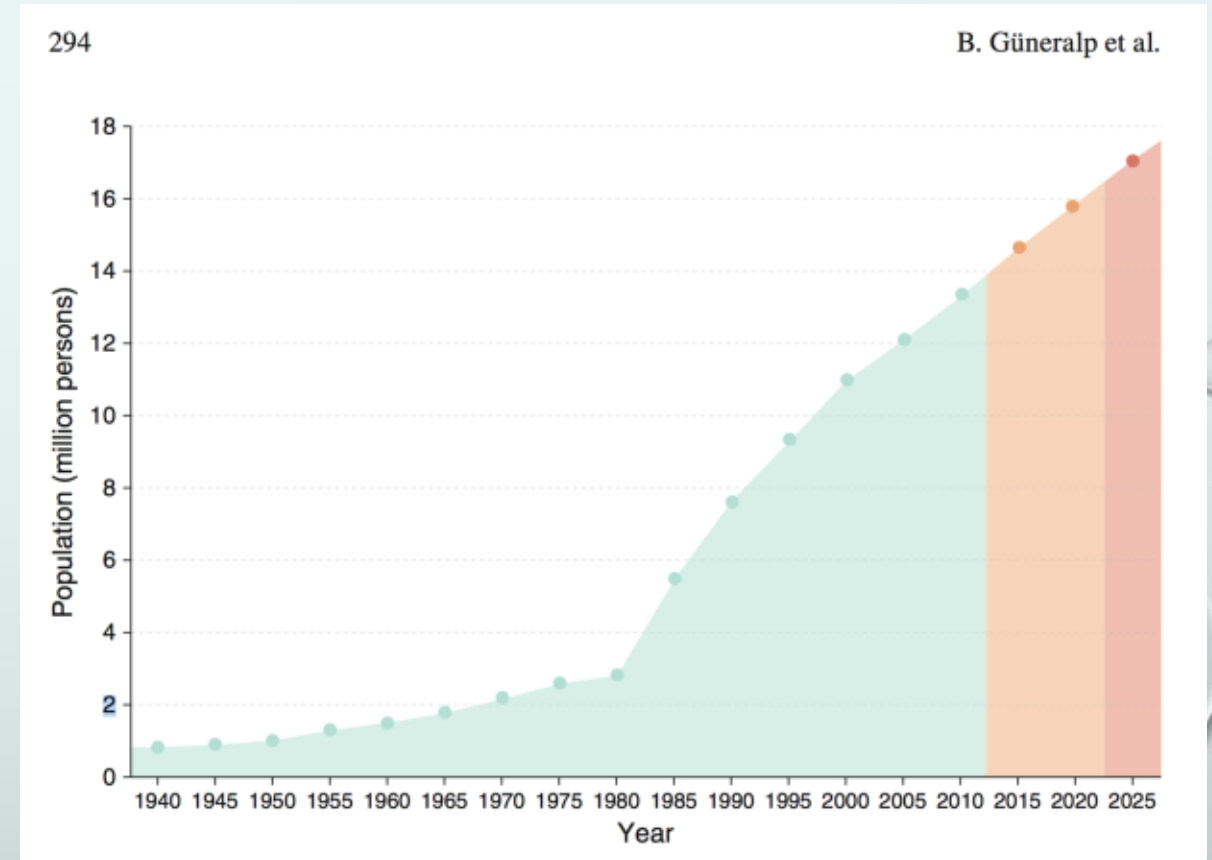


Ecosystem services, biodiversity and city: the case of Istanbul

(B. Güneralp et al., 2013)

Challenges

- Illegal settlements and the approach to deal with the issue
- Enforcement of laws and regulations to protect the forests and basins
- Rapid urban expansion threatens one of the most critical ecosystem services that the city depends upon: the provision of freshwater.
- population growth continues to affect changes in urban structure and place significant pressure on natural resources

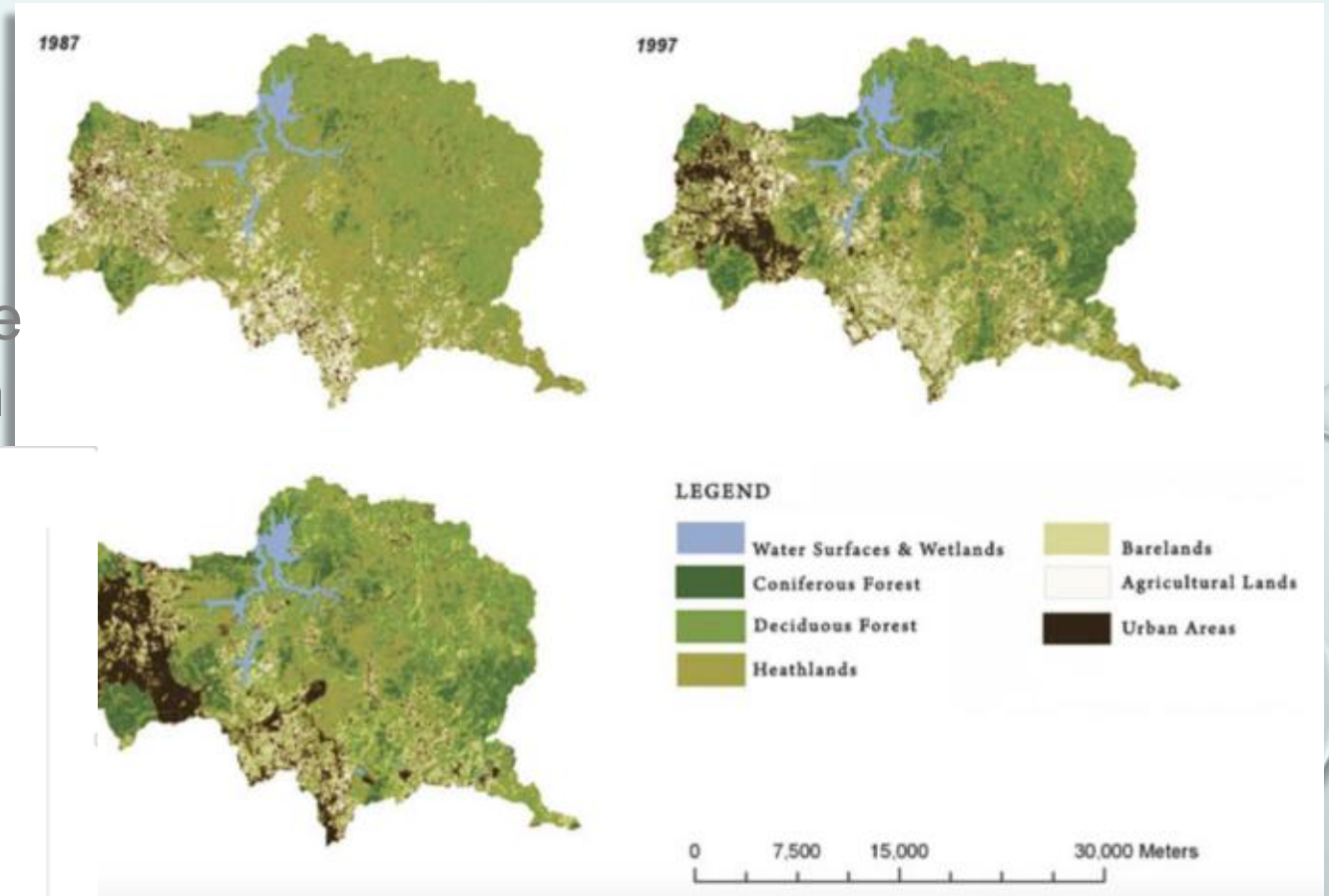
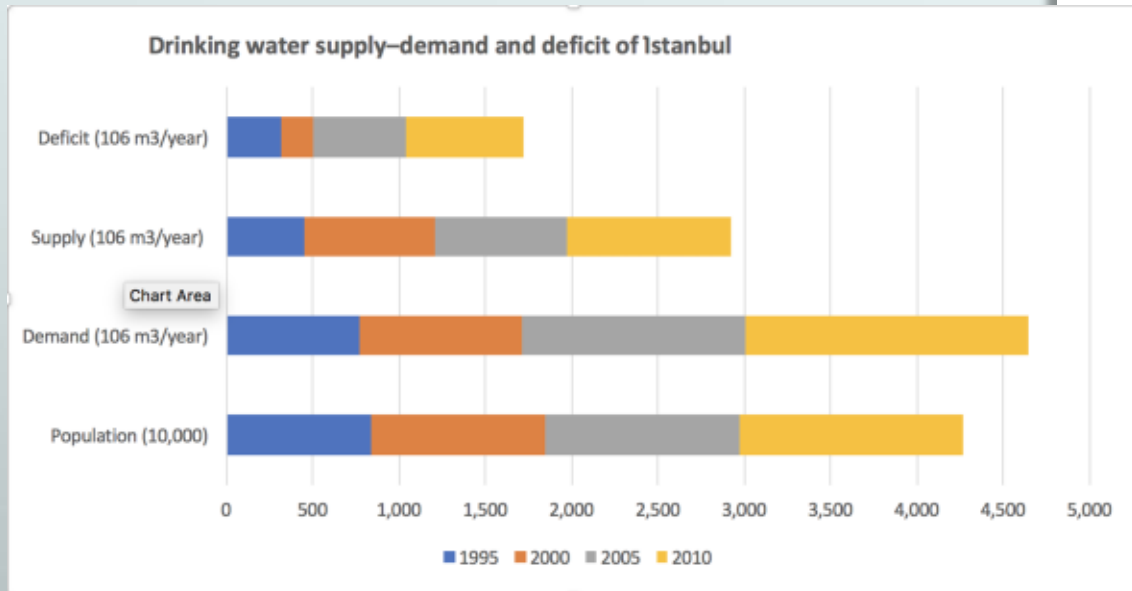


Ecosystem services, biodiversity and city: the case of Istanbul

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Challenges (continued)

- Poor coordination among the multiple responsible authorities
- Fragmented governance structure and the complicated legal system



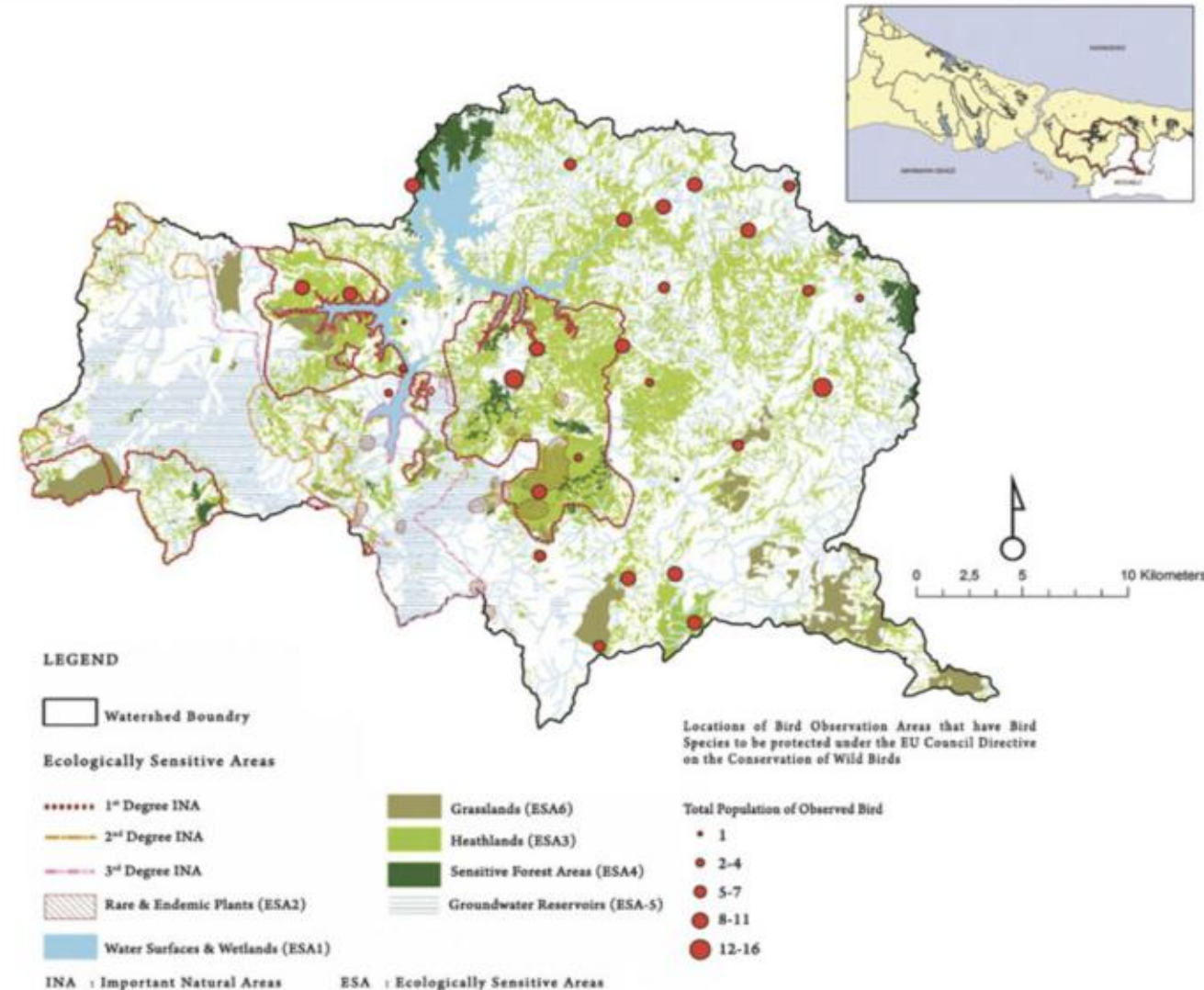
Land use and land cover changes in the Ömerli Watershed, 1987–2006
(Reproduced from Tezer et al. 2011)

Ecosystem services, biodiversity and city: the case of Istanbul

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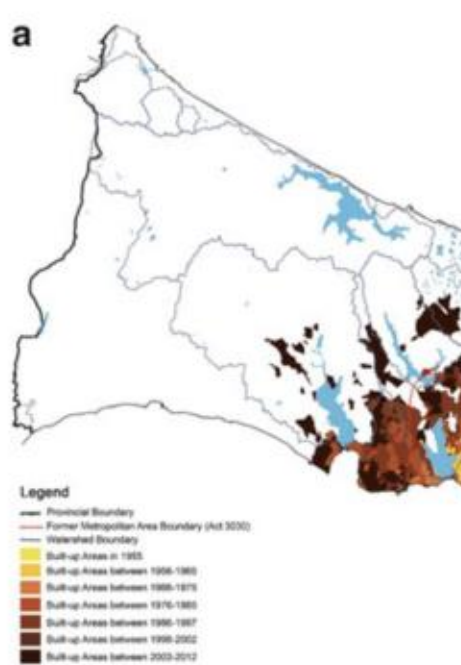
Solutions and way forward

- Mapping the status of the systems
- Extended mandate and management
- Citizen awareness and active civil society
- Capturing value of “ecosystem services” and “natural capital”
- Urban Biosphere Reserve
- Watershed management and enforcement
- Parks and gardens

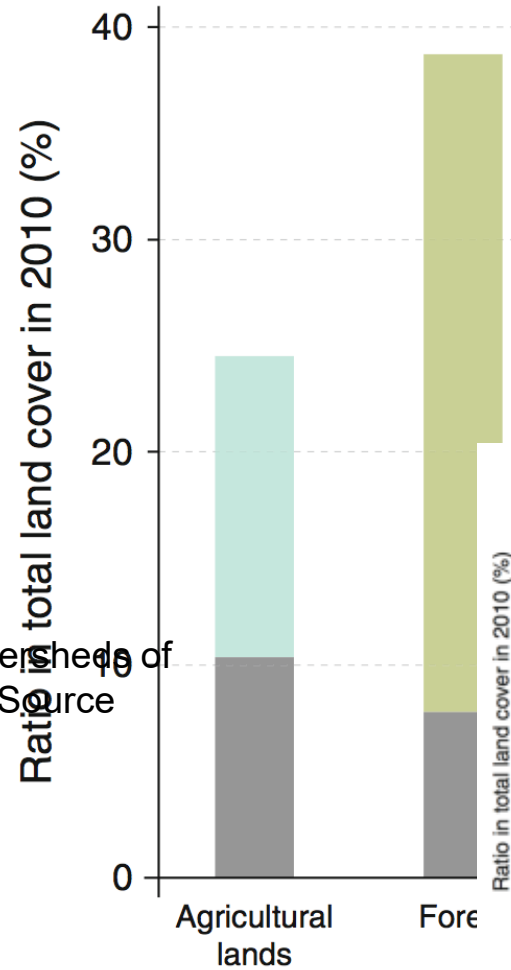


Ecosystem services, biodiversity and city: the case of Istanbul

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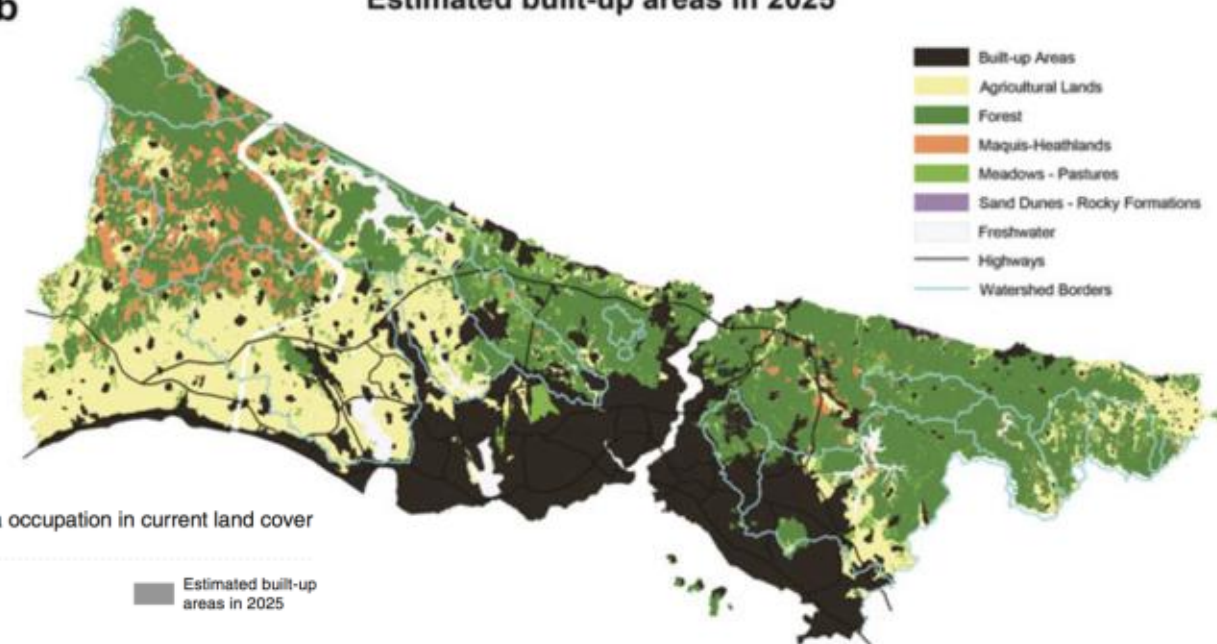


2025 built-up area occupation

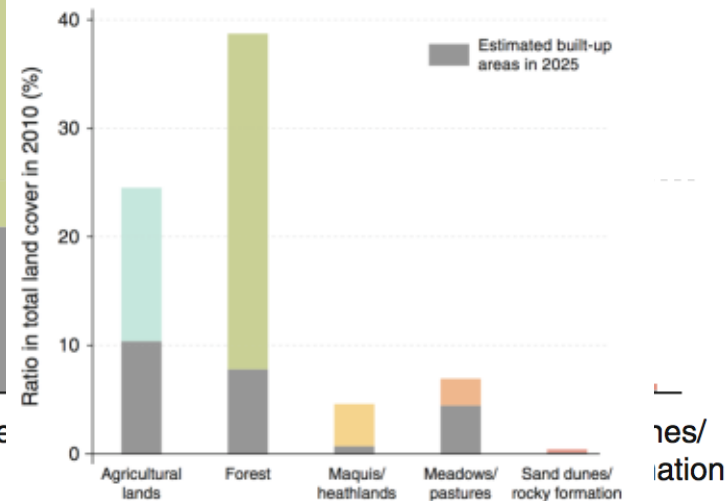


b

Estimated built-up areas in 2025



2025 built-up area occupation in current land cover



(b) The projected changes in land cover by 2025 assuming all planned development projects are realized (Source ©Azime Tezer 2013).



Source ©Azime Tezer
2013



GREEN INFRASTRUCTURE

Green Infrastructure (GI) - Concept

- Nature based solutions in addressing climate change mitigation and adaptation measures within urban environments
- **GI =**
 - Protecting, enhancing nature
 - natural processes are consciously integrated into spatial planning and territorial development(EC, 2013)
- Examples: urban forest, coastal habitat restoration, green roofs



This
is
John
Grey

Green Infrastructure (GI): Interventions and nature-based solutions



Green infrastructure

- ✓ Tree Pits/ Retention Cells
- ✓ Bioswales
- ✓ Green Roofs
- ✓ Roof Top Planters
- ✓ Green Facades and Green walls



Green city

- ✓ 'Daylighting' Rivers
- ✓ Vegetation Buffer Zones
- ✓ Urban Forest
- ✓ Urban Farming
- ✓ Mangrove and Wetland Restoration
- ✓ Riparian Buffer Zones and Ecological Parks – Green Park Connectivity

Tree Pits/ Retention Cells

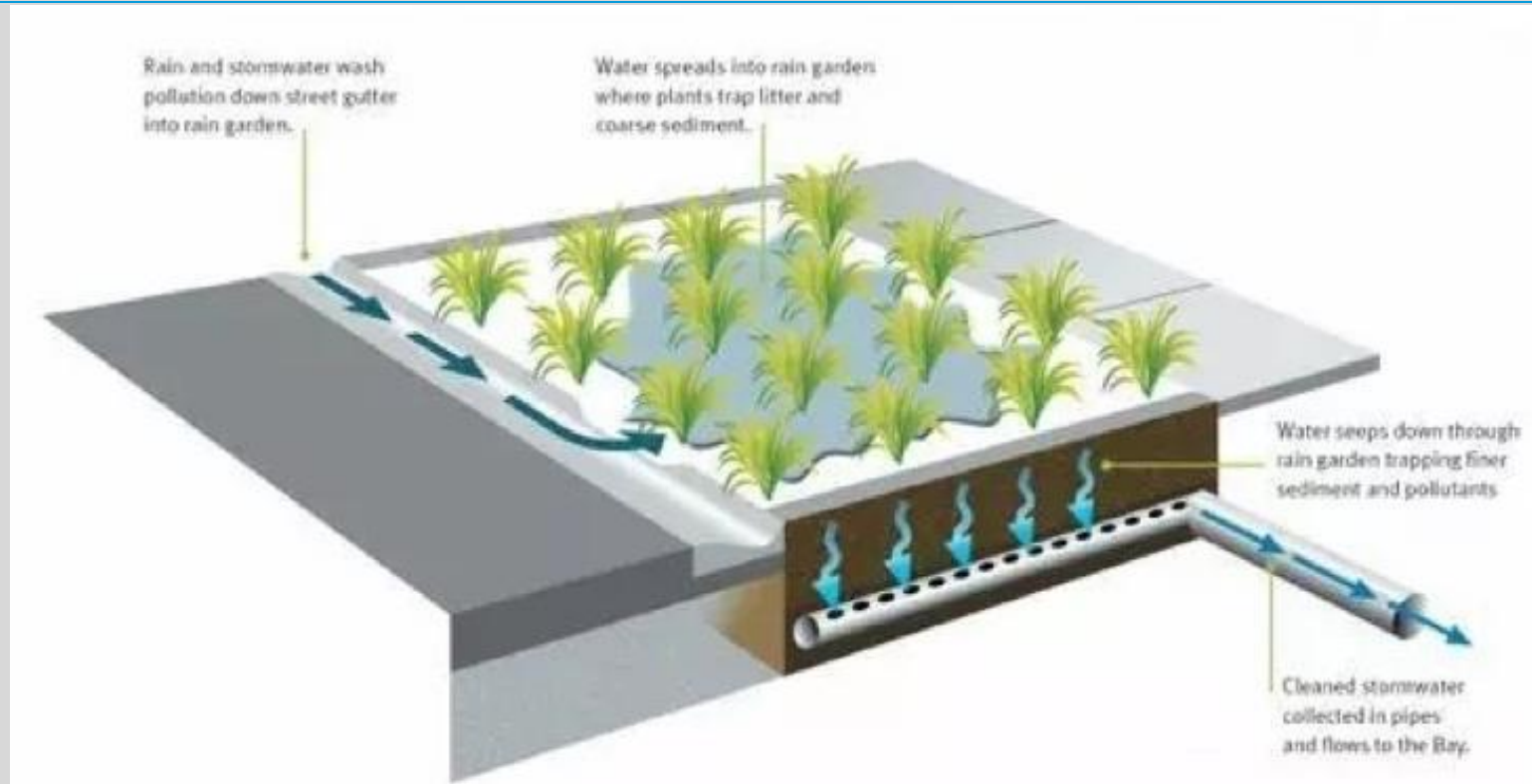
- ✓ Single pit vs Stormwater Tree Trench System
- ✓ High degree of water take up
- ✓ Increase the capacity of water capture
- ✓ Improve the resilience of the trees
- ✓ Location: pavements or parking lots
- ✓ Systems require

maintenance every 5-10 years



Bioswales

- ✓ Stable rainfall events
- ✓ Catches a significant amount of pollutants
- ✓ Systems require regular maintenance
- ✓ Don't look beautiful during periods of drought
- ✓ System require replace periodically



Source: Wilson, 2017

Green Roofs

- ✓ Benefits of heating and cooling requirements of building
- ✓ Reducing usage of air conditioners
- ✓ Do not require additional space
- ✓ Urbanizing cities, and locations with high land values
- ✓ Water availability



Green Roofs



1) Chongqing Taoyuanju Community Center, Chongqing, China © Sergio Grazia

2) Meydan Shopping Centre. World Architects. Photo © Cristóbal Palma



3) © Michael Moran/OTTO for Andrew Berman Architect

Roof Top Planters

- ✓ Planter boxes, contained gardens
- ✓ Suitable for flat roof houses
- ✓ Improved air quality, reducing energy demand
- ✓ Less costly
- ✓ Rental buildings
- ✓ Self-produced food and promote biodiversity
- ✓ Need reinforcement



Source: Wilson, 2017

Green Facades and Green walls

- ✓ Office, commercial and apartment buildings
- ✓ Aesthetic values
- ✓ Solar radiation absorbed by construction materials
- ✓ Cooling costs
- ✓ Require readily available water
- ✓ Public awareness and contact with nature

Source: Wilson, 2017



Green Facades and Green walls



‘Daylighting’ Rivers

- ✓ The process of removing obstructions (such as concrete or pavement) which are covering a river, creek, or drainage way and restoring them to their previous condition.
 - ✓ Increasing storage capacity/flood management
 - ✓ Reduce downstream/localized flooding
 - ✓ Require space, financial/labor intensive
 - ✓ Co-benefits (property value, pollution control, landscape, wildlife)
 - ✓ Require high maintenance
- (Example: Cheonggyecheon river, seoul)

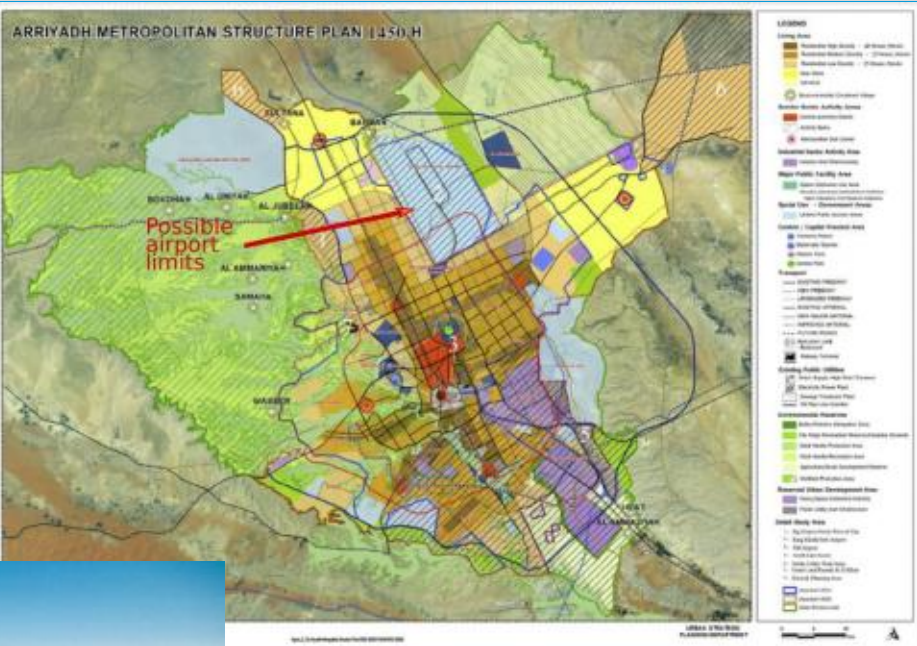


Vegetation Buffer Zones

- ✓ Reduced impacts from dust storms, flash flooding
- ✓ Increased biodiversity
- ✓ Slowing down water movement, wind barrier
- ✓ Creating habitat, improving cooling and air quality
- ✓ Selection of species is crucial



Vegetation Buffer Zones



Mangrove – wetland restoration

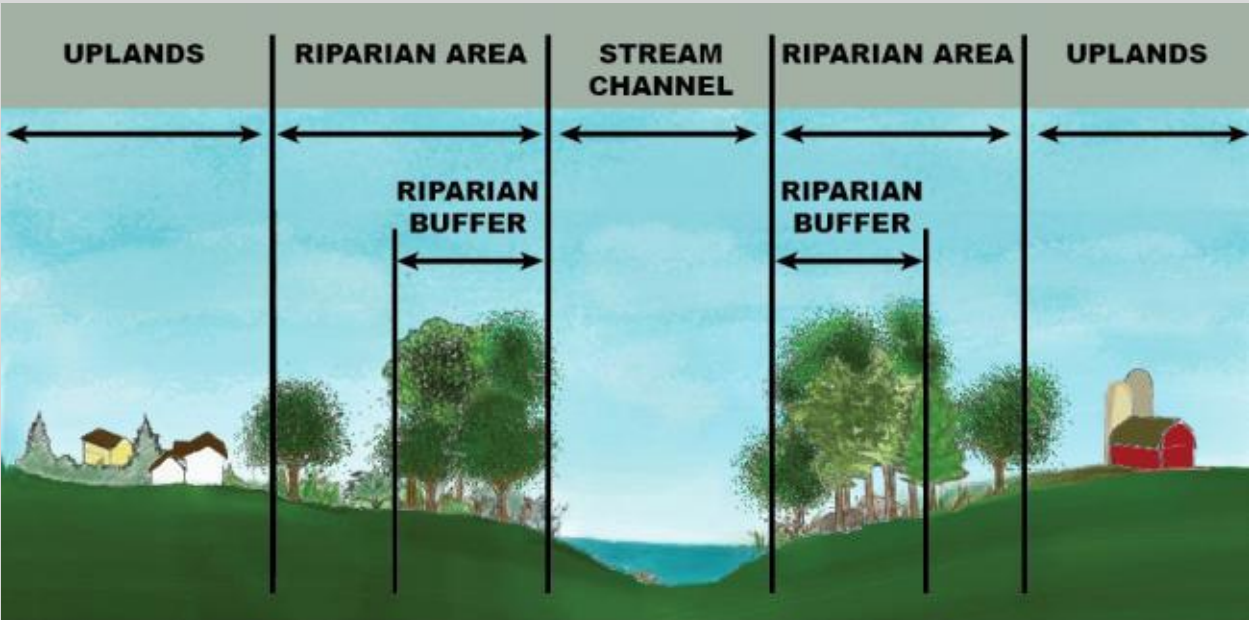
- Significant factor in adapting to climate change, through mitigating the effects of storm surges, sea level rises and salt water intrusion
- Strong relationships between coverage & density and reduction in property damage (Barbier et al 2013)
- High carbon storage ecosystem
- Biodiversity and livelihoods support
- Recreational purpose
- Etc.

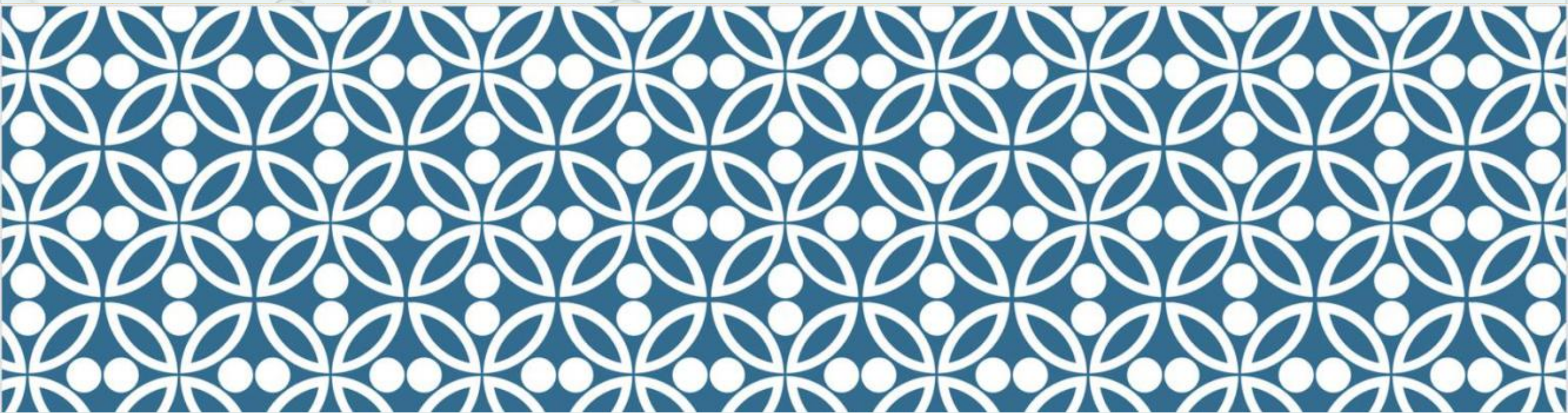


Urban Forest - Urban Farming



Riparian Buffer Zones, Ecological Parks and Green Park Connectivity



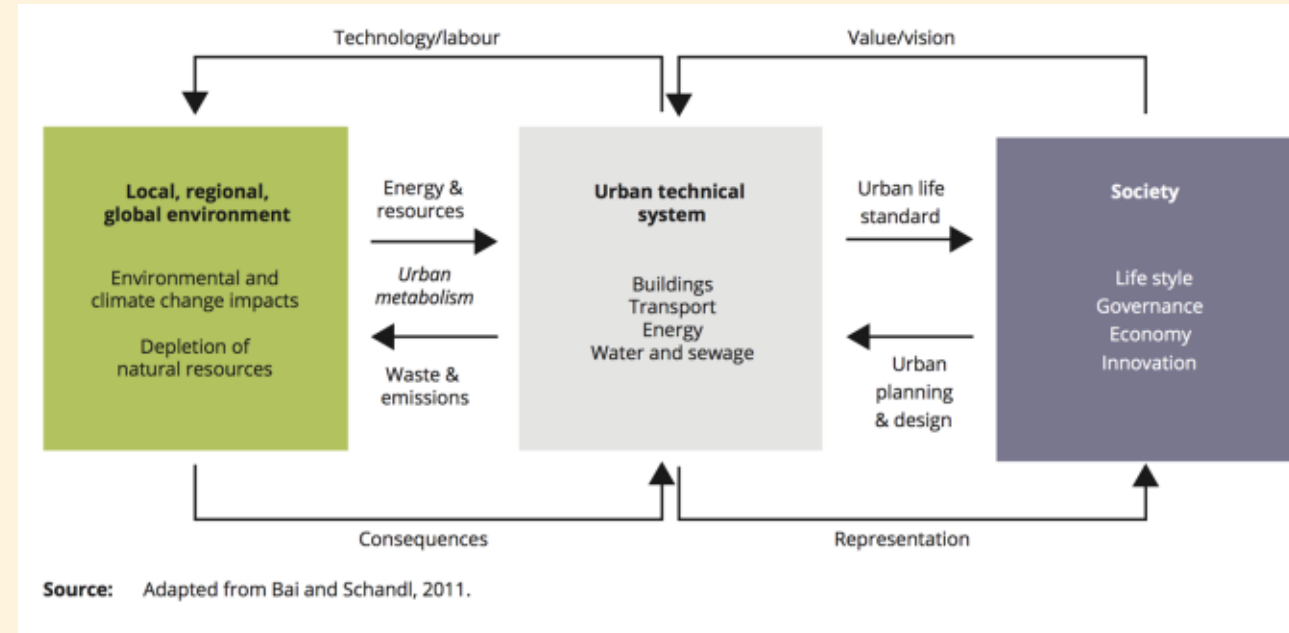


CITY AS A SYSTEM

The urban system

- Cities are sources of problems but, at the same time, they also have a huge potential for resource efficiency
- Need to uncouple social well-being and economic growth from their use of resources
- Better manage resource flows
- It relies on cross-scale interactions among the natural system, the trans-boundary engineered infrastructure (roads, railways, water supply, power supply, etc.) and the different actors

The Urban System

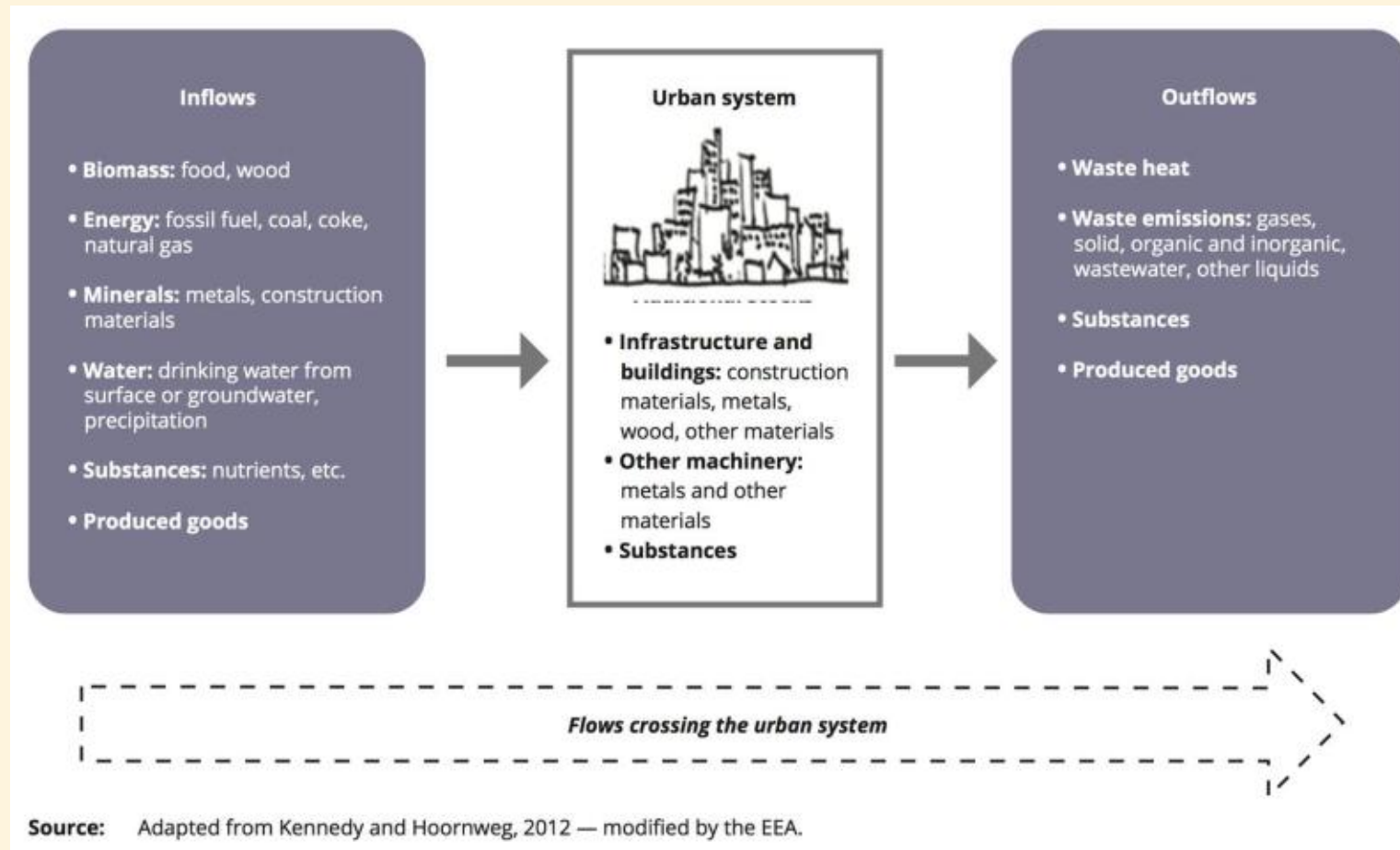


- Urban metabolism needs to be optimized on all scales (building, block, neighbourhood, city)

Cities as a living organism

- Flows and Stocks
- Material flows analysis
 - Mass of input flows = Mass of output flows + stocks
 - Life cycle analysis or life cycle assessment (additional tools)
 - Economic input–output life cycle assessment

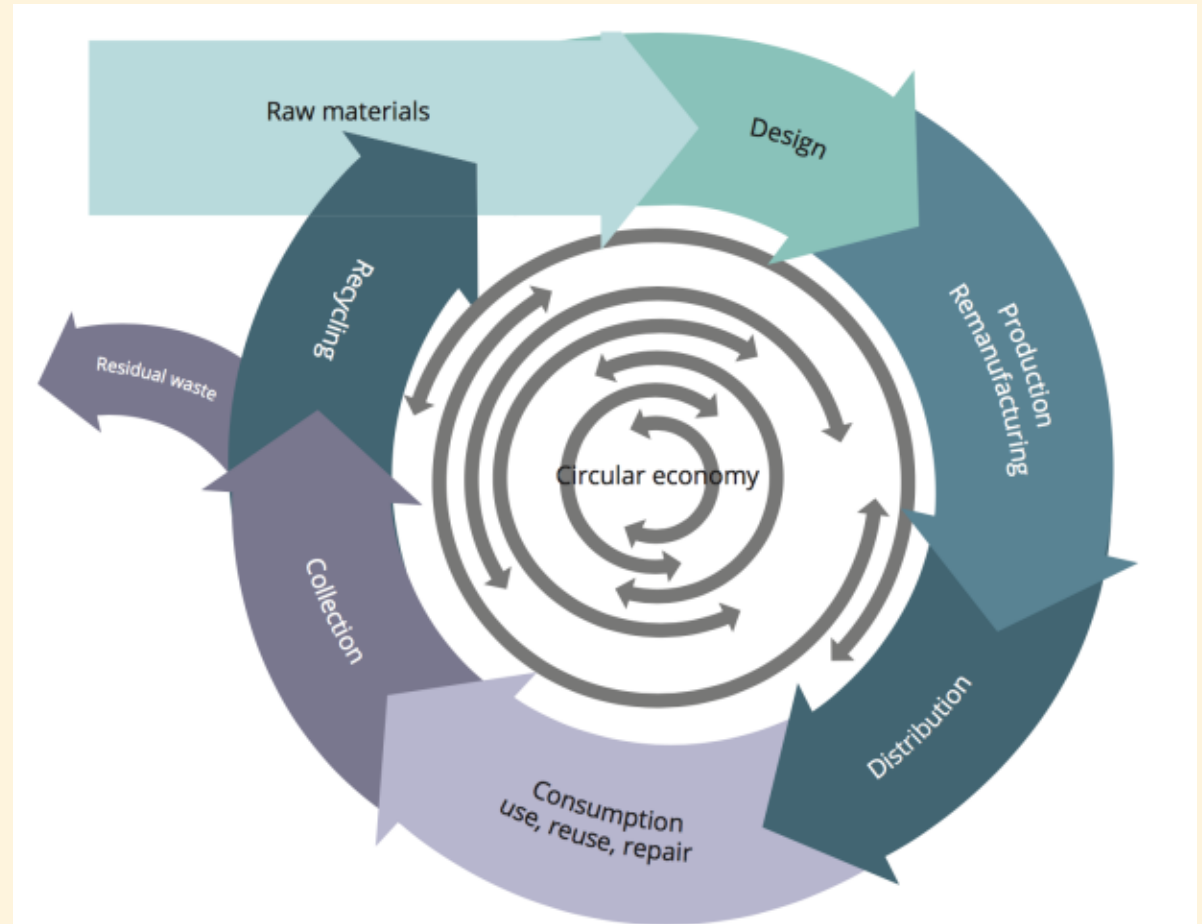
The linear urban metabolism



The circular approach

- Cities need to close the loop of urban cycles
- Recycling and reusing is a way of optimizing the production process by reducing waste, costs and inputs of raw materials
- Ecosystem efficiency
- Urban metabolism can be changed both through policies — urban design and urban planning

The circular economy

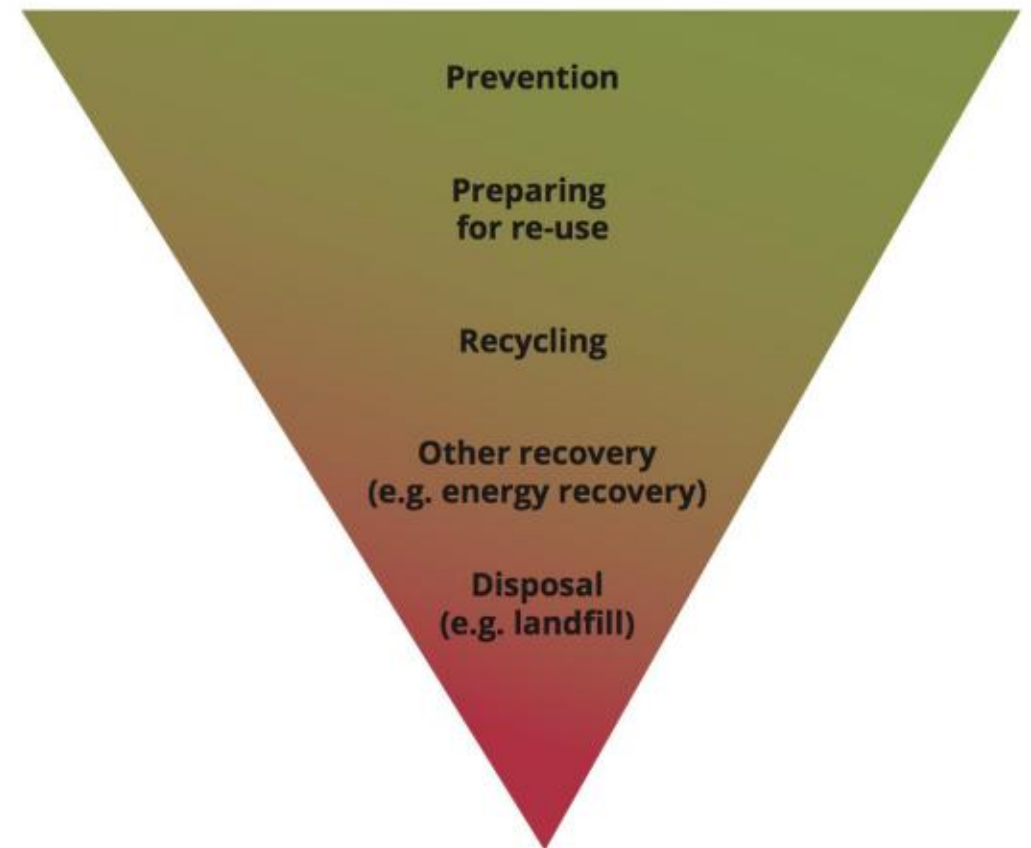


Source: Adapted from EC, 2014

Reducing resource consumption

- Strategies for reducing resource consumption
 - reducing the demand for resources
 - minimising inputs and outputs
 - harvesting (using local and renewable sources such as rainwater, solar and wind energy, urban agriculture)

The waste management



Source: Adapted from EU, 2008.

Cities as a source of resources

- Bio-waste, composting
- Food waste
- Household appliances/e-waste
- Plastic waste
- Waste water
- Concrete, aggregates, bricks, tiles and asphalt



The challenges

- Data
- City's boundary
- People's awareness
- Behavioral changes
- Financial resources
- Technologies and know-how
- Integrated planning



The integrated approach of Copenhagen

- Carbon neutrality by 2025
- Zero emission power production
- Compensate for traffic emissions, wastewater management and industrial processes
- a long-term strategy for an energy supply based on a mix of renewables has been defined
- Use of bikes and public transport
- Focused on quality of life: green areas
- 'European Green Capital' for 2014



Resource-efficient cities: good practice

- **Green infrastructure**

Landscaping
Working with nature
Biodiversity in parks and gardens
Accessible green areas for recreational activities
Green roofs, green walls, linear trees

- **Resource**

Renewable or regional materials for construction
Regional food supply, including from urban areas
Zero-waste city and a circular approach
Zero-land take
Closing the water cycle through collection, filtration and rain gardens



- **Urban planning**

Densification, land recycling, programmes for mixed land use
Retrofitting buildings and infrastructure
Affordable housing
Eco-districts and eco-buildings

- **Urban design**

High quality public spaces
Architecture and place identity
Eco-construction

- **Urban management**

Smart management of resource flows

- **Mobility**

Efficient public transport
Cyclability and walkability

- **Energy**

Production of renewable electricity
Smart grids for efficient use of energy

- **Culture**

Values, behaviour, lifestyle, identity

- **Governance and leadership**

Long-term vision, planning, programmes
Integrated place-based approach
Liveability, health and well-being as main objectives
Cooperation with surrounding areas
Participation of citizens at the decision-making process
Green procurement

- **Education, research, knowledge sharing**

Information to raise awareness, training on sustainability issues
Participation at networks to share experiences

Note: The 'grey' infrastructure system or the urban technico-system (roads, metro, railways, buildings, utilities) determines the spatial extent of the city and the urban pattern (urban form, density, design) (EEA, 2015).

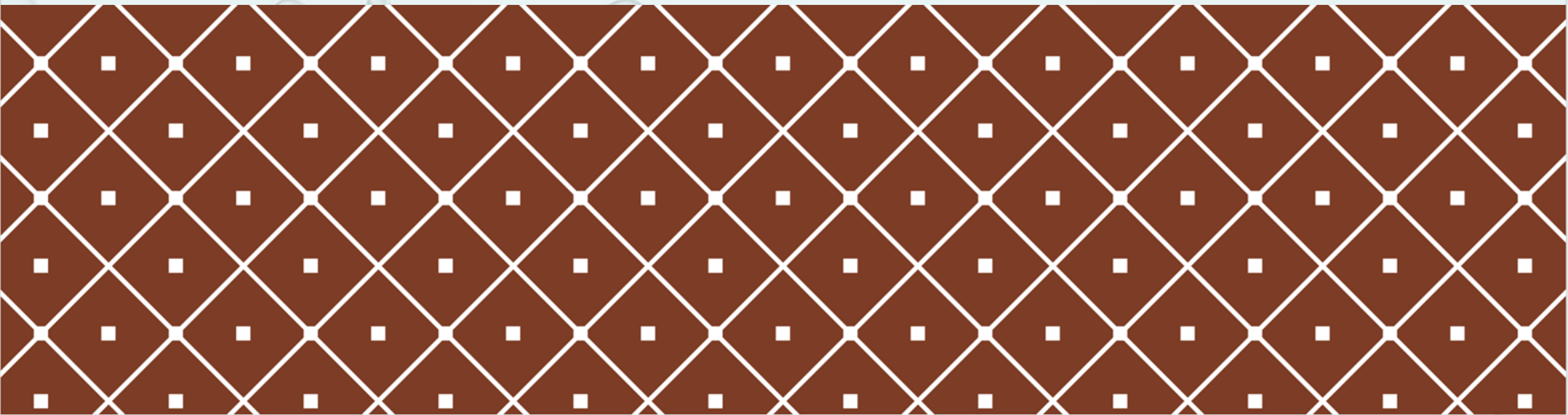
Source: Adapted from Lehmann, 2014.

❖ Leadership and a vision of the future

SIX GOALS AND PRINCIPLES OF RESOURCE-EFFICIENCY

1. Increasing productivity achieved from **same amount of resources**
2. Producing more with a **smaller resource base**
3. Reducing environmental impacts during the whole lifecycle of a given resource by **minimizing waste outputs** or managing their disposal
4. **Reducing demand** for goods and services in order to encourage lower consumption
5. Switching to **renewable resources** away from finite resources
6. **Environmental justice**: Moving towards more equal distribution of resources. Allocating them more equally could address high production needs and waste issues

GREENER CITIES PARTNERSHIP



RESOURCE AND ENERGY EFFICIENCY

Actions taken at different levels of government with the aim of achieving resource and energy efficiency

- Defining a **long-term vision** and strategy
- Providing a supportive **national legal framework** (e.g. building standards)
- **Integrating** resource and energy efficiency goals into the different national policy areas
- Adjusting the degree of **decentralization** of competencies of authorities
- **Funding** local measures
- Funding **research and knowledge development** on resource and energy efficiency
- Raising **awareness** of resource and energy efficiency
- Enabling the development of **new business models** related to recycling and reusing

Green building



The Crystal, London, UK:

- Run entirely on electricity – the majority of which is generated by photovoltaic solar panels
- The building's roof collects rainwater, while sewage is treated, recycled and re-used onsite.

(c) Pawel Libera, LightRocket, Getty Images



Vanke Center, Shenzhen, China:

- Being tsunami proof – Shenzhen sits on China's south coast, next to Hong Kong
- Photovoltaic solar panels sit atop the structure's roof
- All furniture, doors and floors are made from bamboo.

(c) View Pictures, Universal Images Group, Getty Images



Rene Cazenave Apartments; San Francisco:

- Built as an urban regeneration project
- Filtered ventilation, low emitting materials, ample daylight and views combine,
- Combination of high efficiency lighting and hydronic heating, a continuously insulated rain-screen building envelope and a roof top solar canopy with both hot water and photovoltaic panels.
- Water is carefully managed by a vegetated roof, smart irrigation, a courtyard storm water tank and reclaimed water piping...

Green building

- Green building is the practice of creating structures and using processes that are **environmentally responsible** and **resource-efficient** throughout a **building's life-cycle** from siting to design, construction, operation, maintenance, renovation and deconstruction.
- This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort.

Green building is also known as a sustainable or high performance building.

Energy (concept, design, installation, audit...)

Water (harvesting, efficiency, filtration)

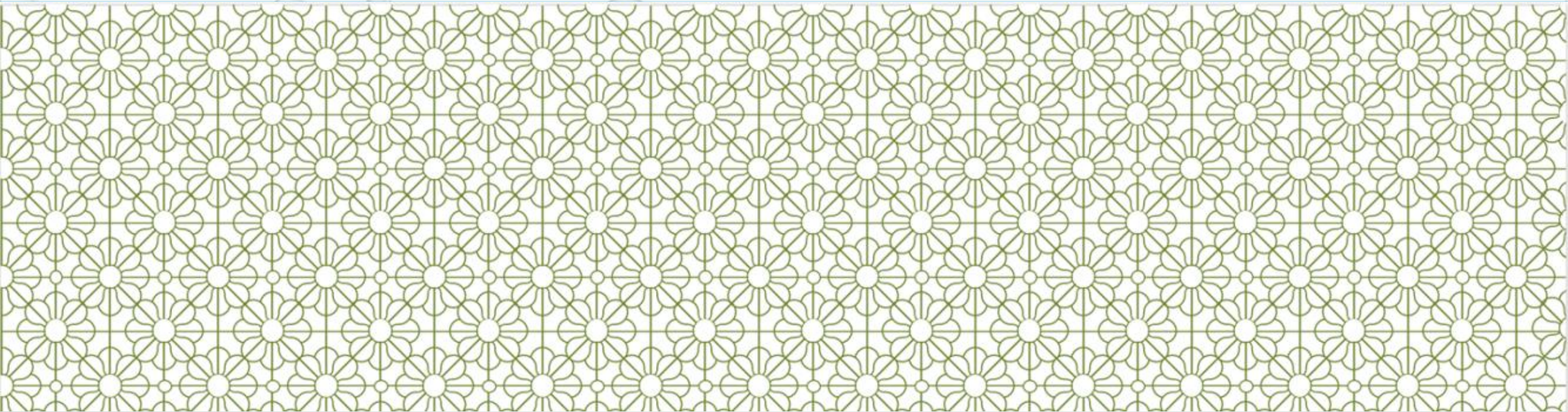
Waste water (recycled water)

Solid waste management (3Rs)

Materials (Carbon footprint, locally available etc.)

Life Cycle Assessment

- [EU guidelines](#)
- <https://www.ifu.com/knowtheflow/>
- <https://energy.gov/eere/femp/building-life-cycle-cost-programs>
- [BEES](#) (Building for Environmental and Economic Sustainability)



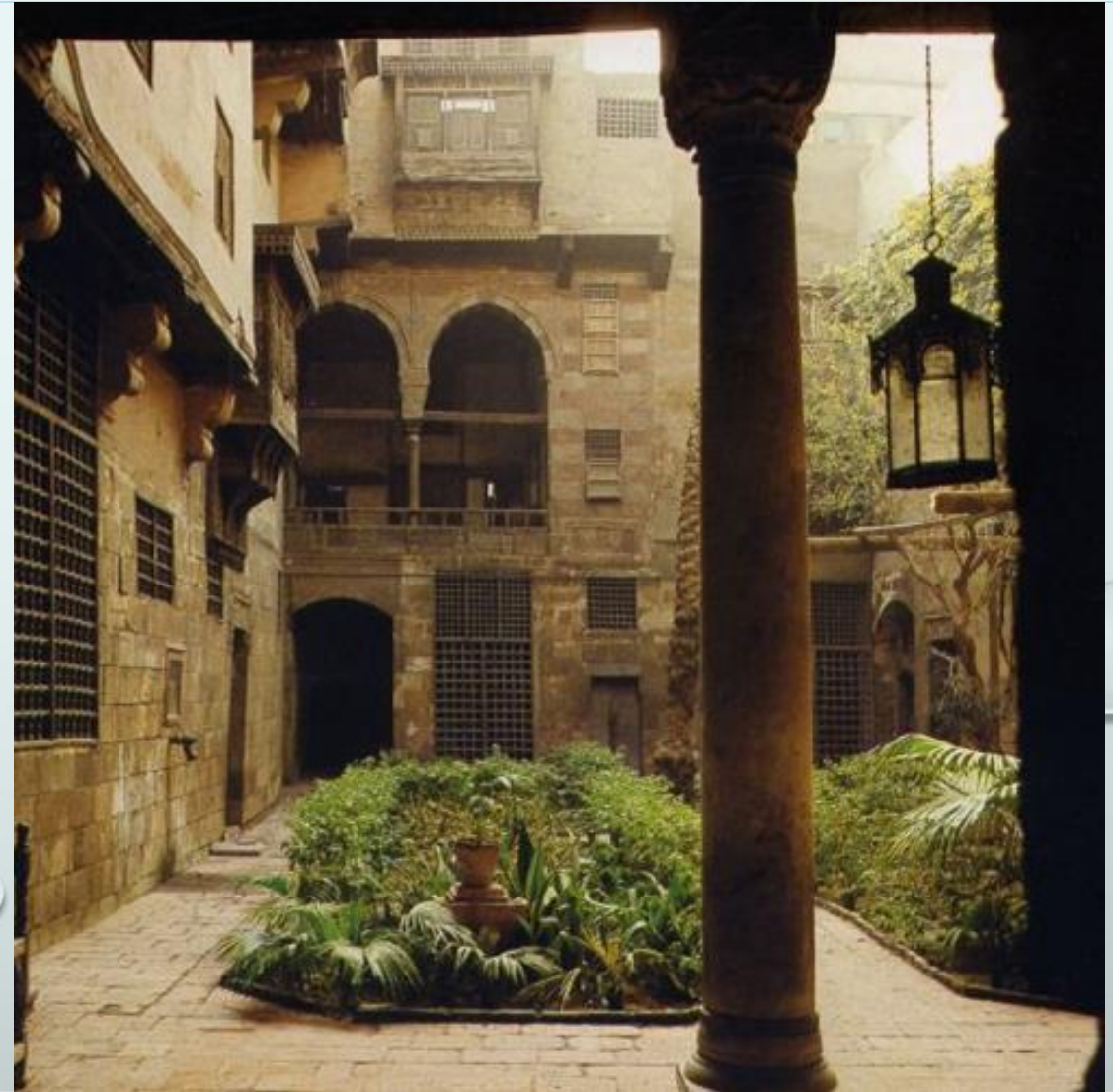
GREEN SPACE

Context and trends

- The struggle against aridity over centuries has fundamentally shaped cultural and technical methods of interacting with the landscape, resulting in many vernacular practices.
- The formation of old settlements in the region was highly interlocked with the ecological structure of the land.
- With modernization, many vernacular practices gradually faded away, largely due to urbanization and rising modernization of methods and techniques.
- Rapid urbanization in the last two decades has modified and changed the integration of culture and the physical landscape and has led to destruction of long-established ecological-cultural systems.
- Western ideals of progress and globalization shifted the desire away from continuity and connection with the historic, cultural relationships in landscapes to the extent that the interests of many decision makers are focused on imported materials, technologies, forms and concepts.

Where do they locate?

- There has been a long history of designed public open spaces in the region: these include public and private courtyards, the souk or the bazaar, and even the narrow shaded alleyways in the dense residential



The benefits of green space

- Ornamented function
- Micro climate regulation
- Quality of life (biking, walking, play ground)
- Mental health
- Biodiversity in city
- Carbon storage
- Flood prevention
- Prevent soil erosion/desertification



Are they available?

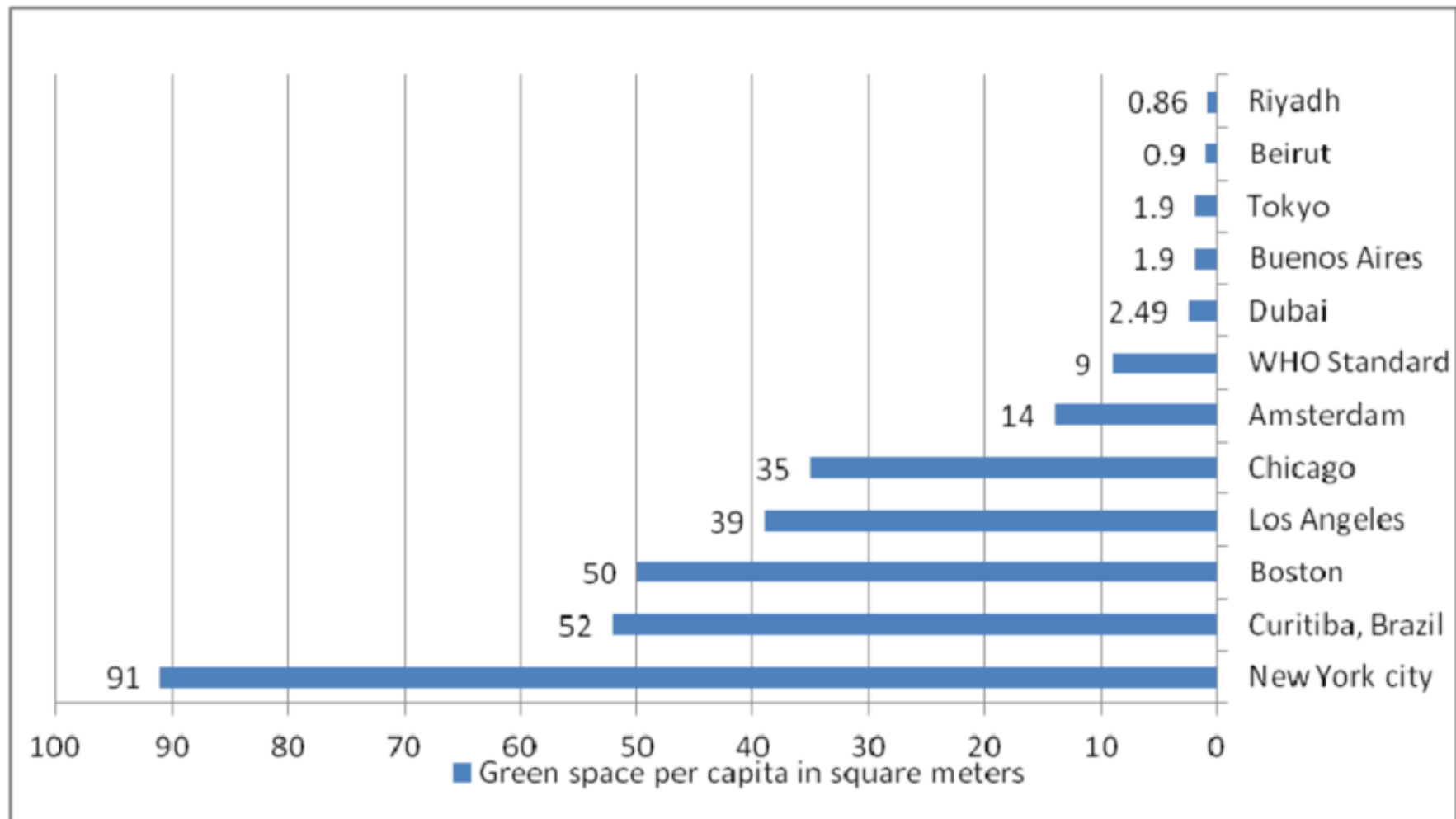


Fig. 1. Green space per capita in selected cities (prepared by the author).

Source:
Almayouf 2013

Examples of gardens and green public space



Source:
Alamy 2013



CO-BENEFITS

What is a Co-Benefit

- The **positive effects** that a policy or measure **aimed at one objective might have on other objectives**, irrespective of the net effect on overall social welfare.
- Co-benefits are often subject to uncertainty and depend on local circumstances and implementation practices, among other factors.
- Co-benefits are also referred to as ancillary benefits.

(IPCC 2014)





GROUP DISCUSSION