Urban Environment

Isabel Wetzel
UN-Habitat
Isabel.Wetzel@un.org

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FOR A BETTER URBAN FUTURE

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What to expect?

- Key concepts in sustainable urban environment and urban environment management.
- Relevant examples and case studies for references
- Key considerations for integrating sound and sustainable urban environmental solutions in city climate change action plans

- A Map of Urban Environment
- Ecosystem and Biodiversity
- Green Infrastructure
- City as a System
- Resource and Energy Efficiency
- Green Public Space

Why urban environment?

Cities impacts on the environment

Direct impacts	Indirect impacts
Change in land cover → Loss of natural habitats and biodiversity (forest, wetlands, lakes etc.)	High pressure on agriculture land and natural resources (food, timber, materials)
Disturbance to and fragmentation of ecosystems	Trans-boundary pollutions (air, water)
Localized pollutions (air pollution, noise, solid waste)	Trans-boundary waste (e-waste, plastic waste)

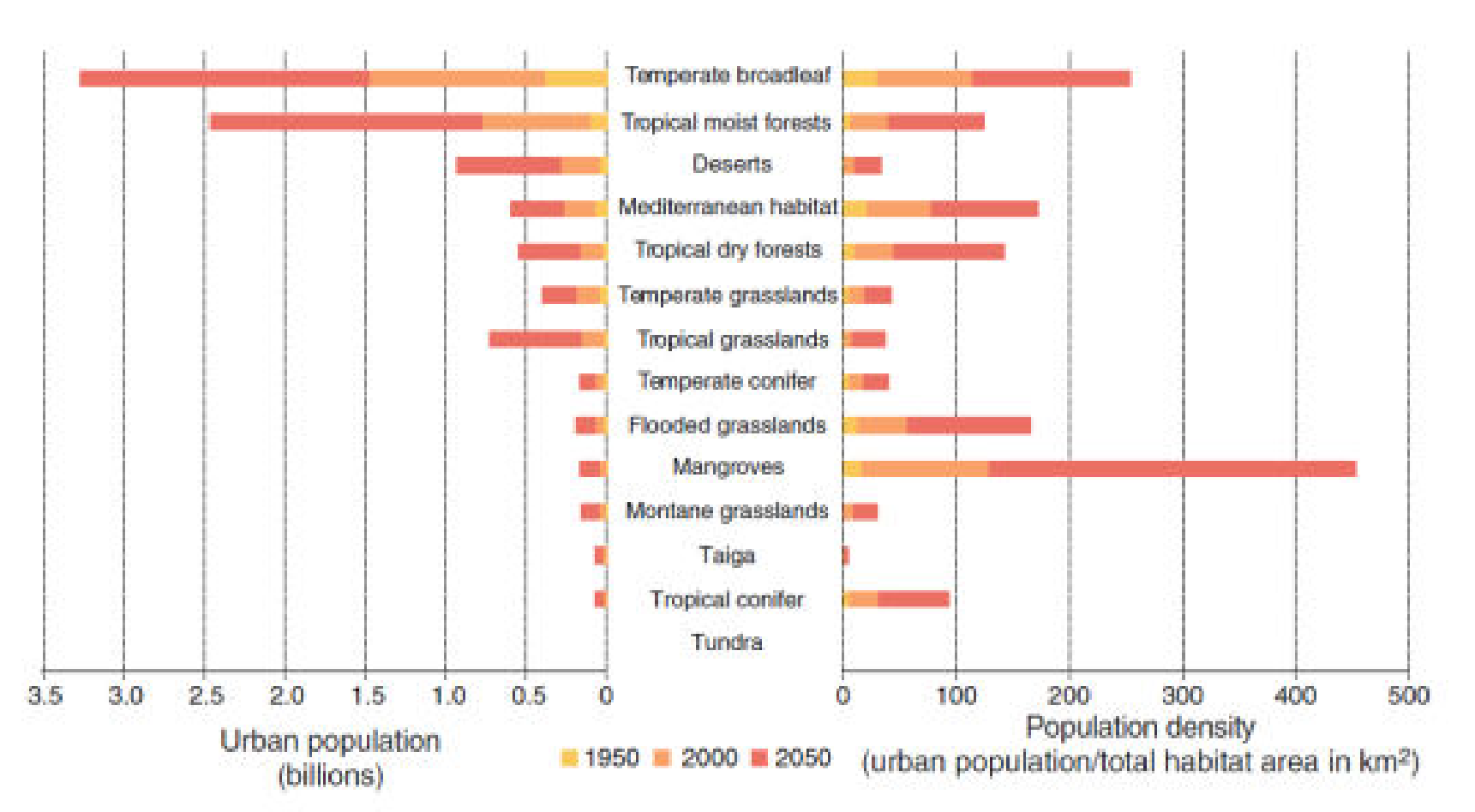
Cities depend on the environment

- ❑ Spatial development/land
- ❑ Water
- ❑ Energy
- ❑ Food
- ❑ Materials
- ❑ Transport
- ❑ Recreational facilities
- ❑ Economic/tourism

Urbanization has externalities to cities and people and…

Urbanization also brings solutions and opportunities

Why urban environment?



Urban population by major habitat type (left panel) and urban population per total habitat area by major habitat type (right panel) (UN-Habitat 2013)

Key features of a sustainable urban environment?

Clean and healthy

- Air
- Water
- Food
- Waste
- Safety

Controlled pollutions

Efficient and Resilient

- Energy
- Resources
- CC Adaptation
- Disaster risks mitigations

Resource efficiency

Green and pleasant

- Biodiversity, ecosystem
- Parks, trees
- Walking zones
- Bicycle lanes
- Art/Spiritual/Sport facilities

Biodiversity ecosystem public space

Green governance

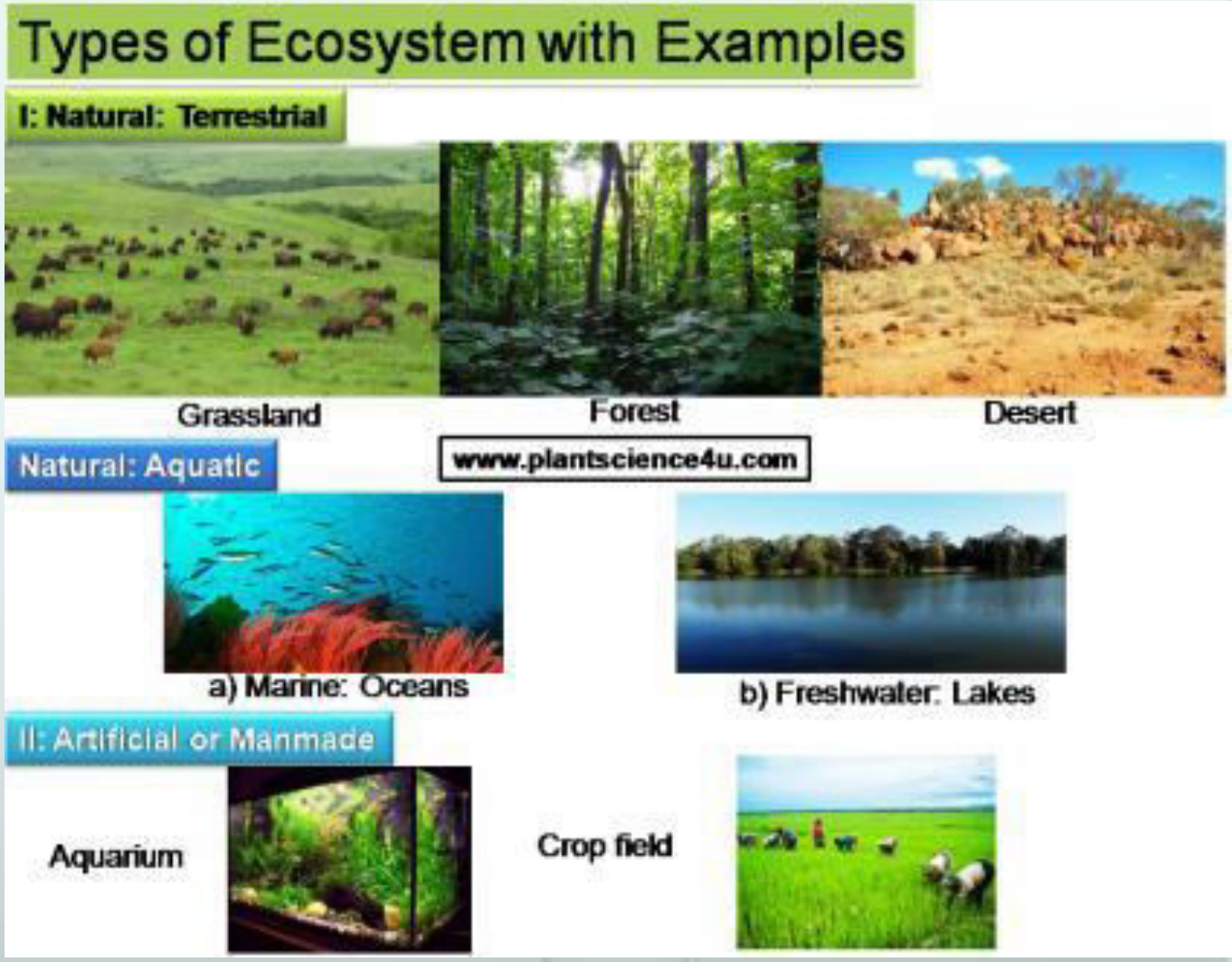
- Laws and Regulations
- Integrated Planning
- Public participation
- Environmental monitoring

Governance

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



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	Waste-water treatment	Maintenance of genetic diversity	Tourism
Fresh water	Erosion prevention	Pollination		Inspiration for culture, art and design
Medicinal res.	Biological control			Spiritual experience and sense of place

Source: TEEB, 2017

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/

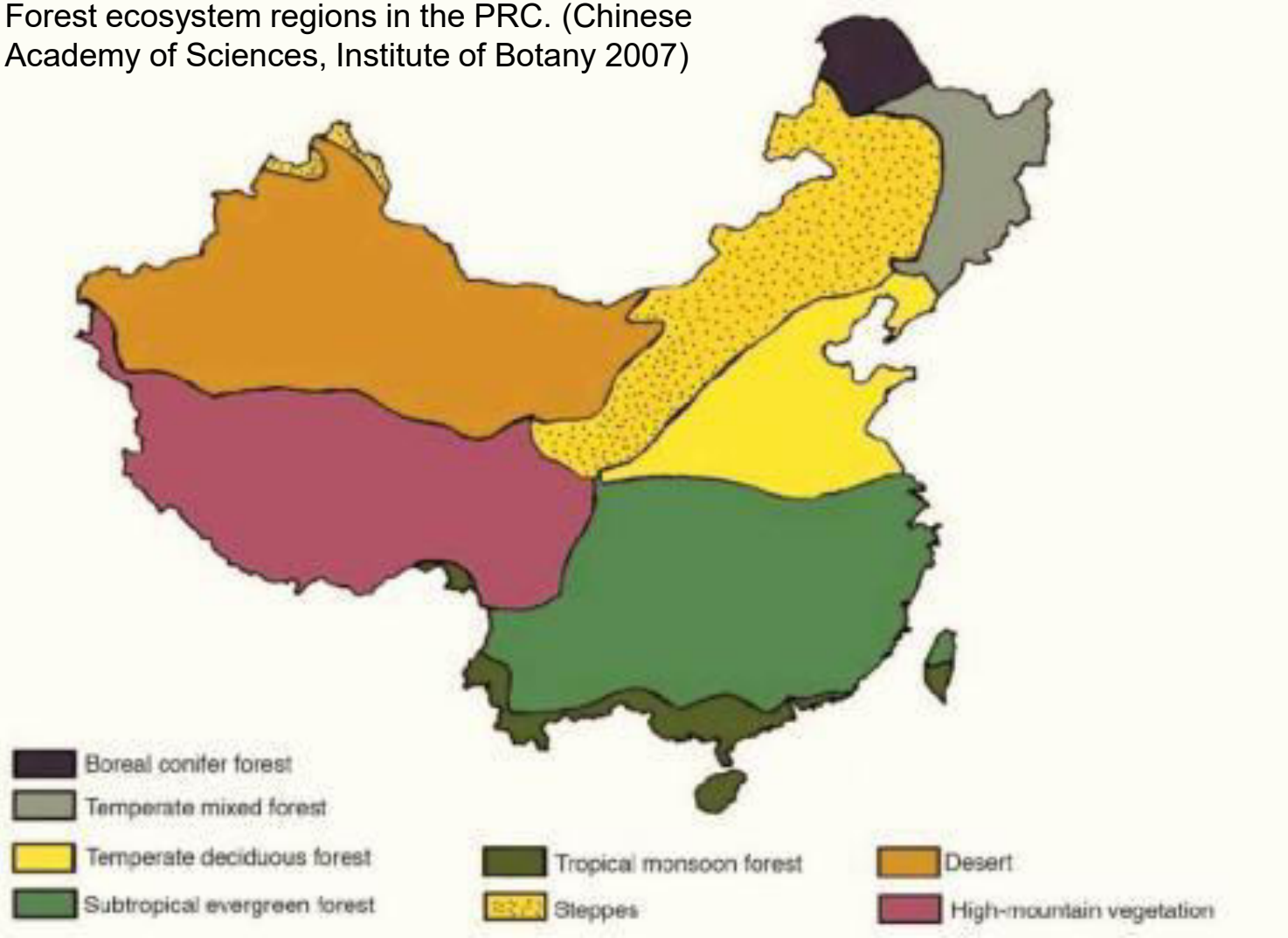
Balancing urban growth and ecological conservation: a challenge in planning and governance in China

Context

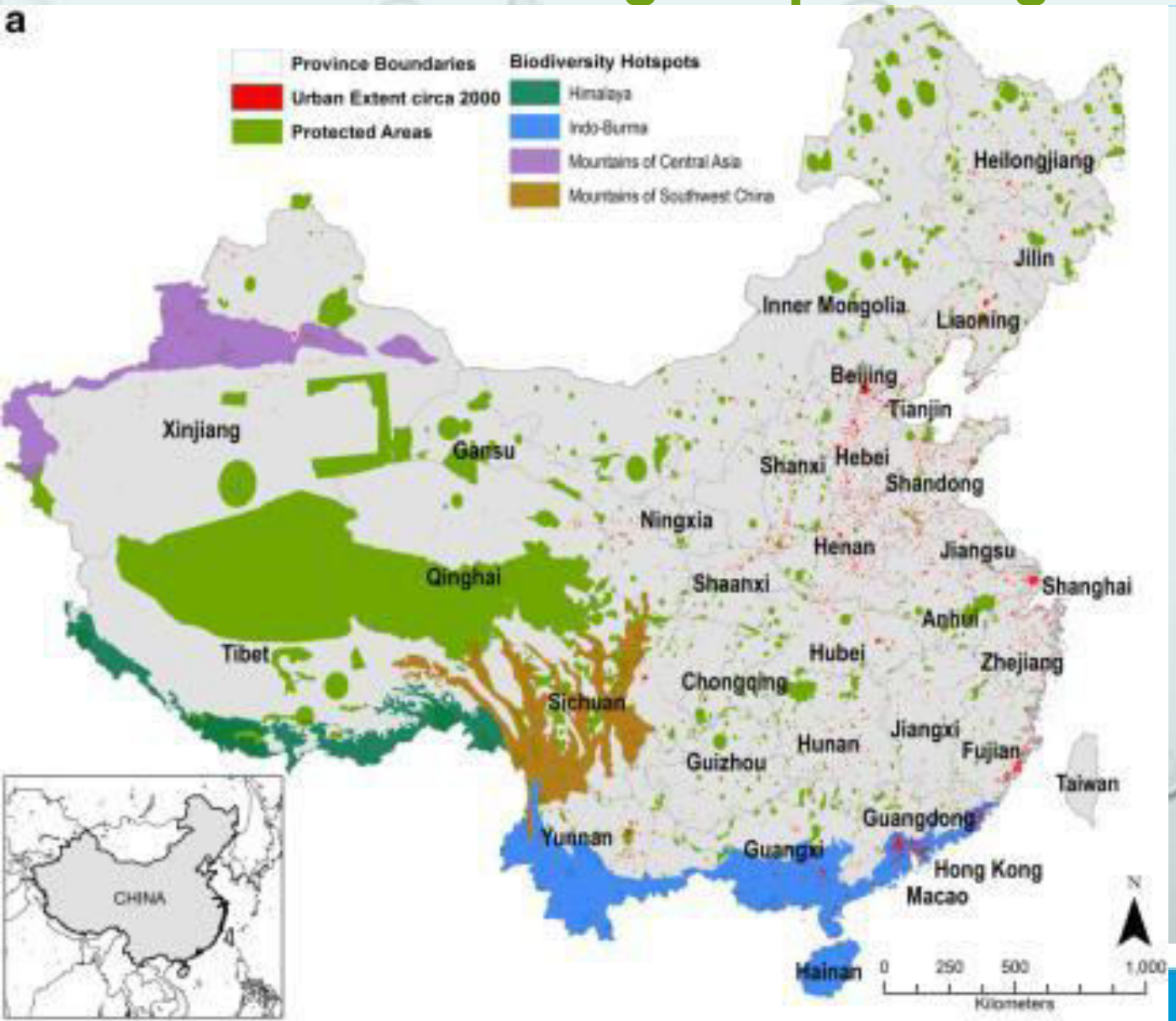
- One of the most biologically diverse countries
- Total 1,865 nature reserves, over 10% of the country's areas
- Fast economic growth since 1980s
- Urban population increased (including rural-urban population migrations): over 800 million people, more than 59% of total populations
- Rapid urbanization and disappearance of ecosystems

(Güneralp en Seko 2013, Güneralp et al 2015, Worldometer 2018)

Forest ecosystem regions in the PRC. (Chinese Academy of Sciences, Institute of Botany 2007)



Balancing urban growth and ecological conservation: a challenge in planning and governance in China



Urban extent circa 2000, PAs, and biodiversity hotspots in China

Findings

- Nearly 4500 km2 of the terrestrial PAs with IUCN status were already urbanized
- Coastal regions : the spatial concentration of both PAs and urban areas are particularly high
- Yunnan province - exceptionally rich in biodiversity in the southwest of the country - had the most urban land in its PAs
- Urban land within 50 km of the PAs will increase on average nearly 150 % by 2030 across the country (in some province the projection is 200%)

(Map from: Güneralp et al 2015)

Balancing urban growth and ecological conservation: a challenge in planning and governance in China

Challenges

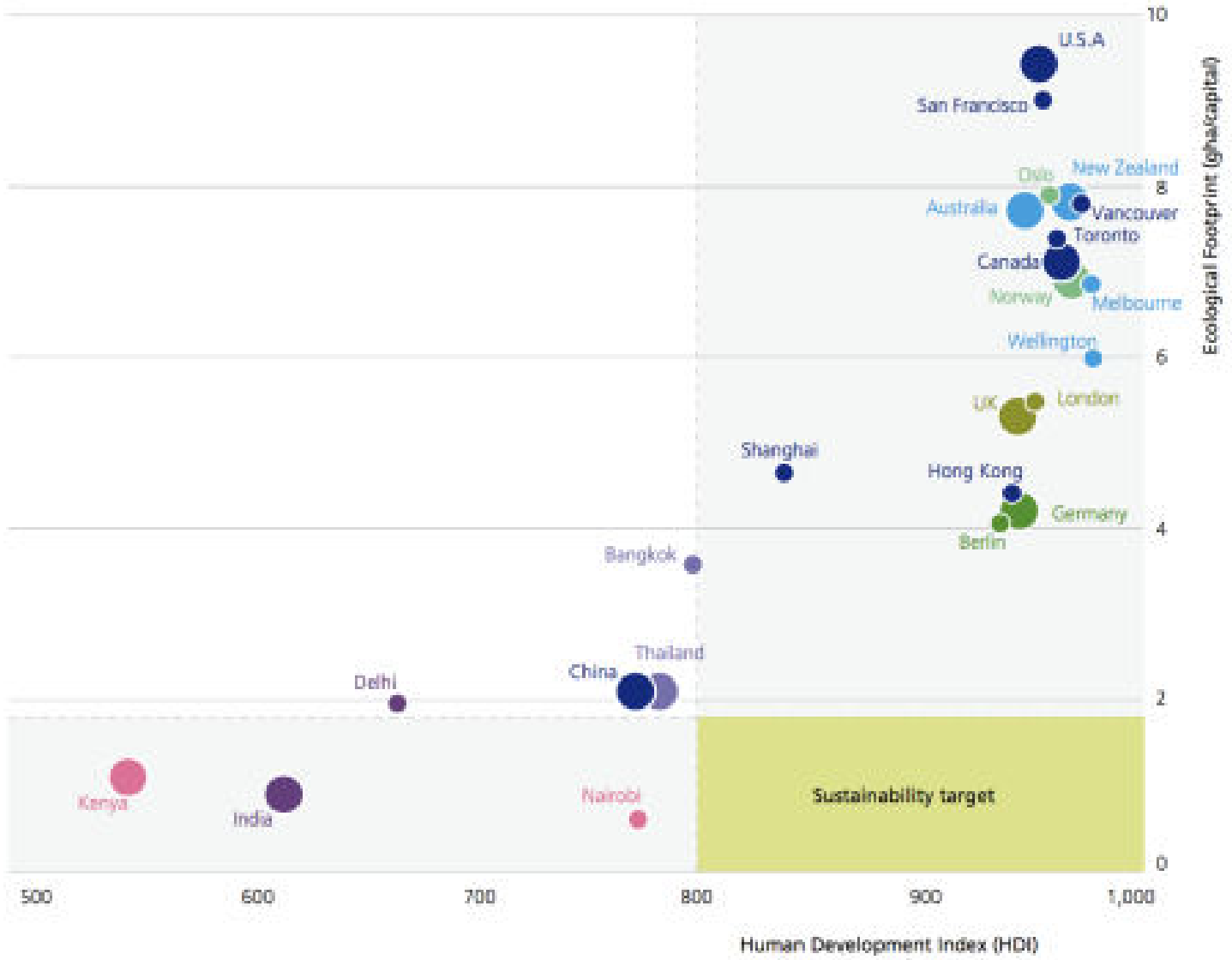
- Local officials favor rapid urban expansion over more careful and ecologically-minded urban planning
- Land and fiscal policy emphasizes on raising revenue for local government
- Enforcement of rules and regulations: E.g. compliance between urban plan and the comprehensive land-use plan is not always met;
- Lack of incentive for integral planning

Solutions

- Oversee role of Ministry of Housing and Urban and Rural Development; Ministry of Land and Resources
- City and Town Planning Law and City and Town System Planning tools
- Comprehensive land-use plans
- Integration of natural resource protection into the planning process

CITY AS A SYSTEM

Cities' ecological footprint

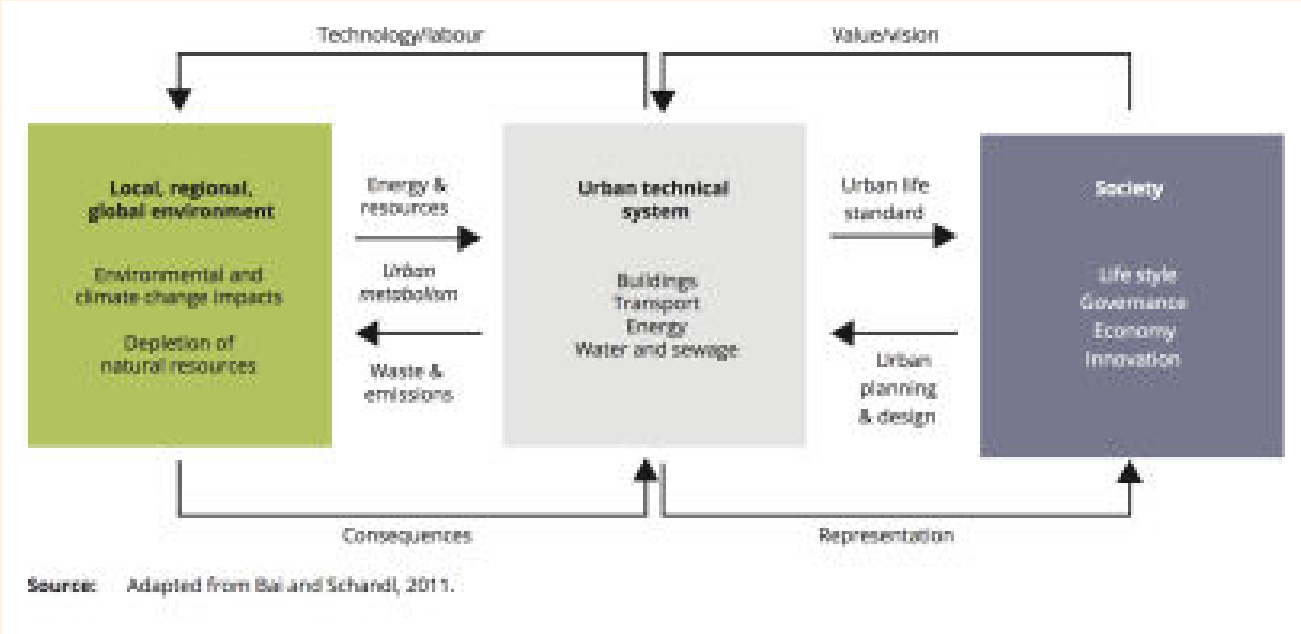


Ecological Footprint and Human Development Index for selected countries and cities

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



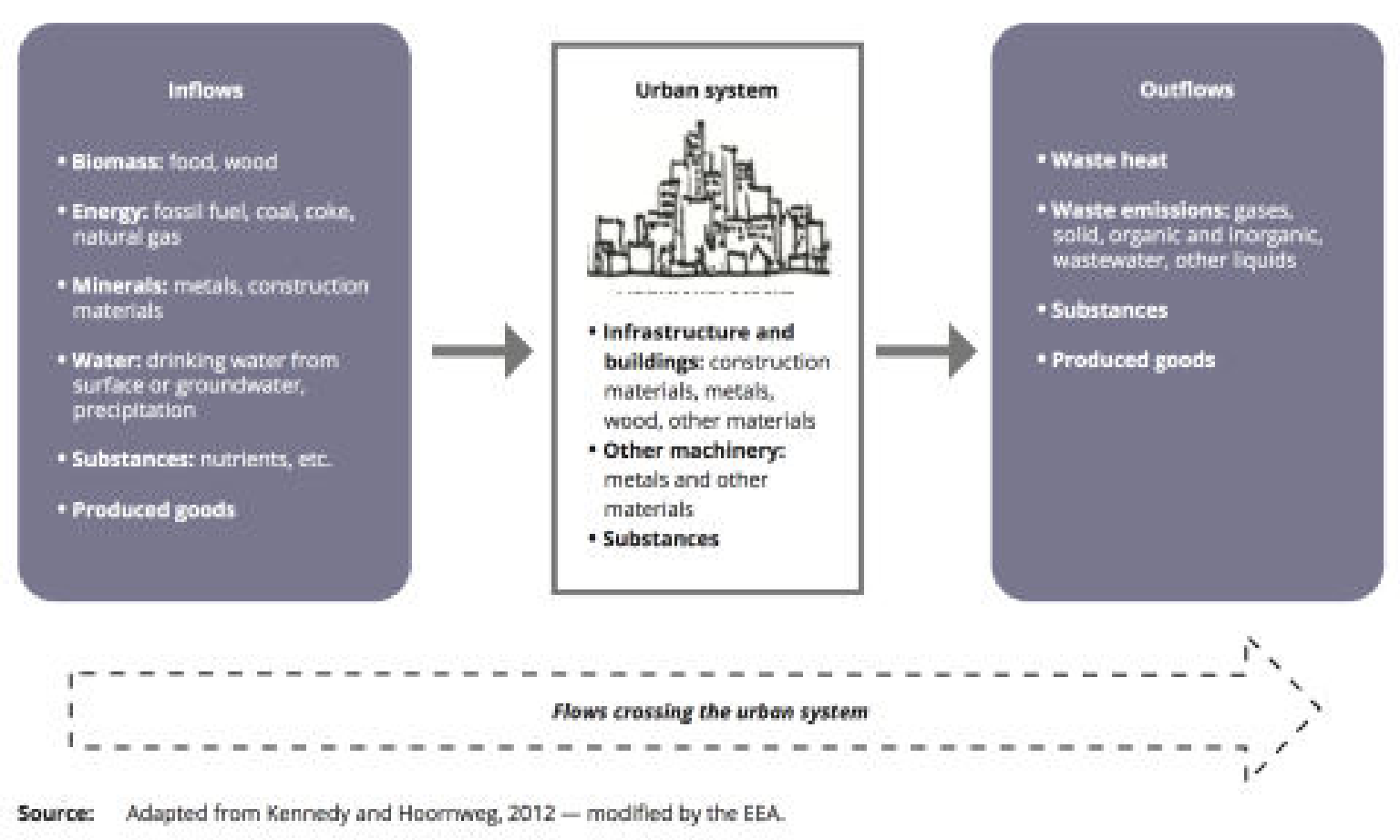
Source: Adapted from Bai and Schandl, 2011.

- Urban metabolism needs to be optimized on all scales (building, block, neibourhood, 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

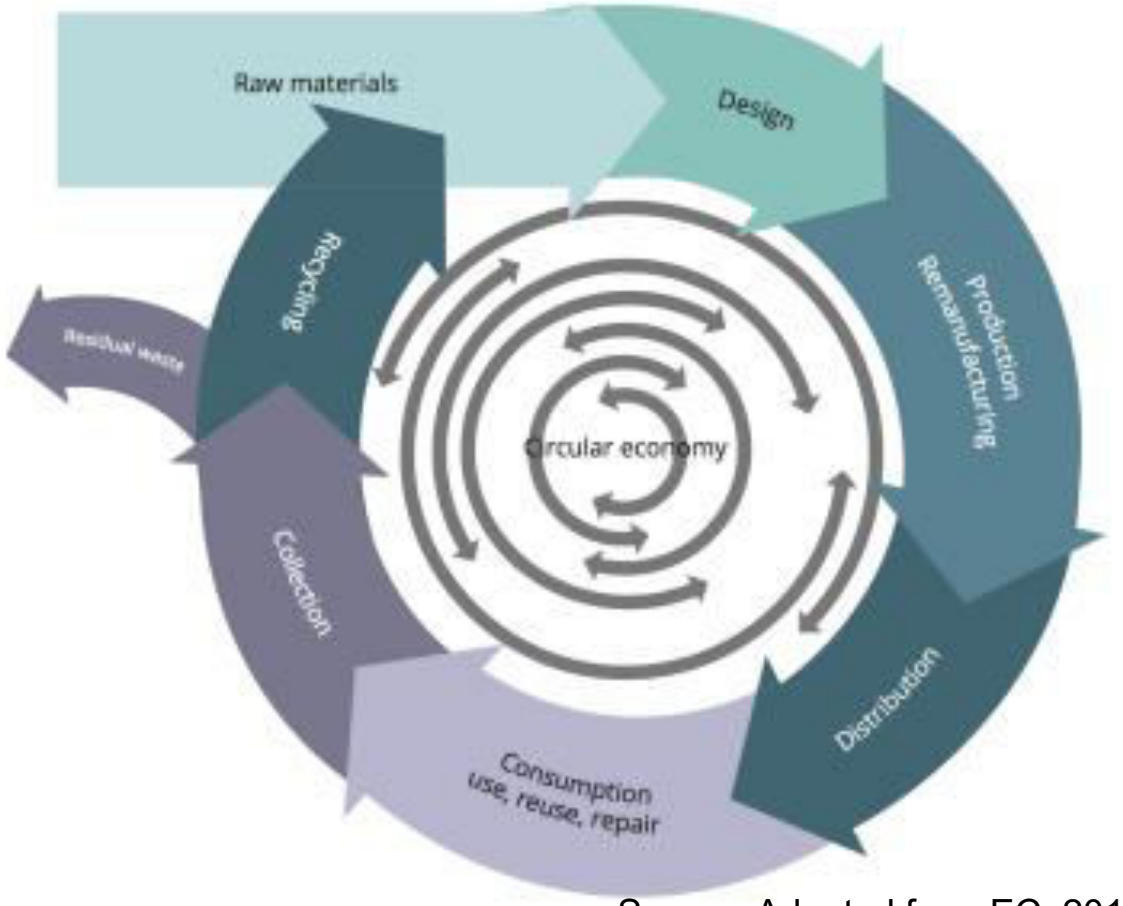
The linear urban metabolism



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

The Greener Cities Partnership

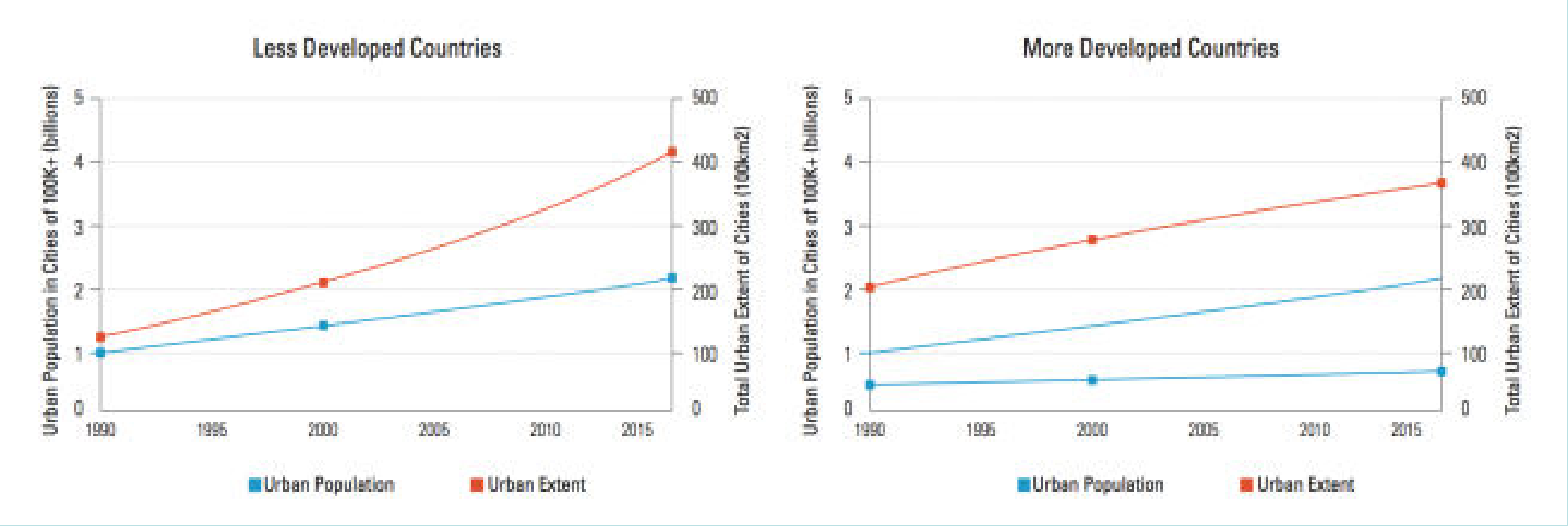
A Joint UN-Habitat and UN-Environment Initiative

SIX GOALS AND PRINCIPLES OF RESOURCE-EFFICIENCY

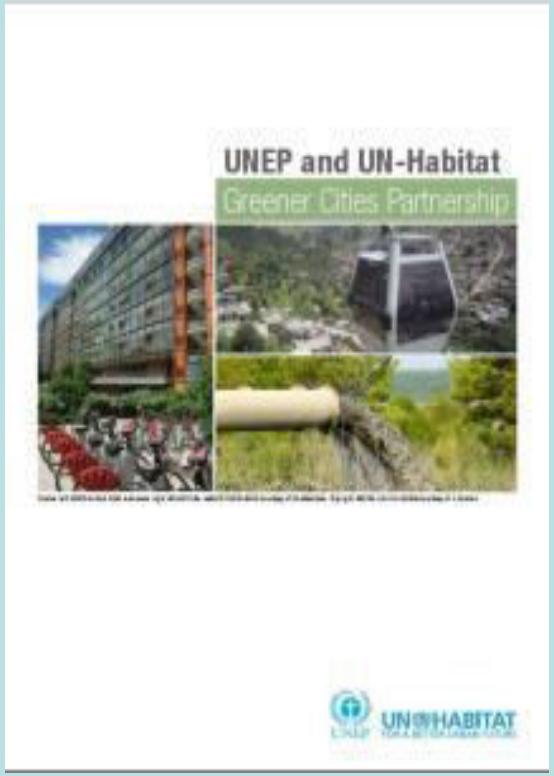
1. Increasing productivity achieved from **same amount of resources**
2. Producing more with a **smaller resource base**
3. Reducing environmental impacts during the whole lifecycle of a given resource by **minimizing waste outputs** or managing their disposal
4. **Reducing demand** for goods and services 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: BACKGROUND AND RATIONALE

- Over 50% of the global population now lives in cities and it is expected that 70% of humanity will be urban by 2050.
- As cities **lose density** and **intensify sprawl**, they lock themselves into unsustainable land use patterns.



URBAN CONSUMPTION AND PRODUCTION



By some estimates, urban areas:

- Occupy 3% of the land surface
- Produce 80% of the global GDP
- Consume 75% of the earth's natural resources
- Account for 60-80% of global GHG emissions
- Produce 50% of global waste
- Cities are key for **tackling climate change** and **generating jobs**

CITIES AS OPPORTUNITIES FOR RESOURCE-EFFICIENCY

- 30% water savings globally
- 30-50% energy savings potential
- USD 41 trillion in investment required for urban infrastructure in the next 20 years

GREENER CITIES PARTNERSHIP

Recognizing the importance of urban issues in the global Environmental agenda, UN-Environment and UN-Habitat have joined forces in a Partnership on Greener Cities.

Objectives of this cooperation:

- Mainstream the environmental perspective into urban policy-making
- Incorporate urban perspectives into environmental policy-making
- Highlight the local-global linkages of environmental issues

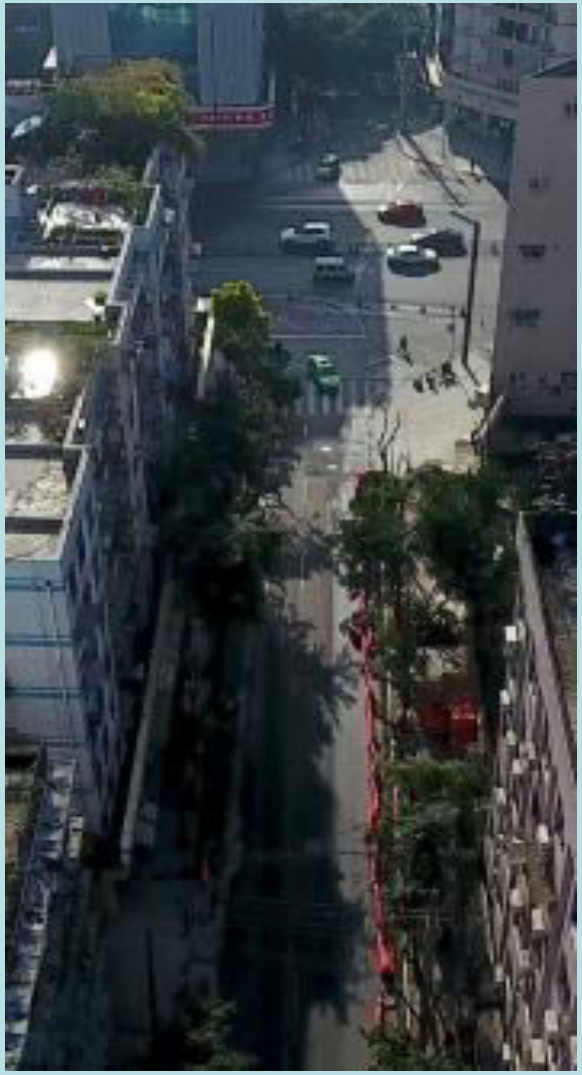
OUR PRIORITIES: 3 PILLARS OF THE PARTNERSHIP

1. **Resilient & Resource-Efficient Cities**
   - Sustainable consumption and production (SCP)
   - Innovative initiatives for resilient, resource-efficient cities
   - Nature-based solutions to urban planning
   - City level ecosystem based adaptation (EbA)

2. **Sustainable Transport & Mobility**
   - Bus rapid transport (BRT) and non-motorized transport (NMT) facilities, two-wheelers and electric mobility
   - Transport components and policies of climate strategies
   - Action plans for sustainable transport

3. **Waste & Waste Water Management**
   - Global monitoring of IWM strategies, comprehensive waste strategy, capacity building activities
   - Knowledge dissemination

QUICKLY EXPANDING TO OTHER AREAS



- Monitoring and reporting on urban environmental (**SDG**) **indicators**
- **Financing** for Greener Cities
- Analysis of environmental challenges of cities in **ecologically vulnerable** locations (coastal areas, islands, mountains, deserts, etc.)
- Integrated **nature-based** solutions to urban planning
- **Green public space** in cities
- **Urban air quality** monitoring
- Civic **participation** in urban environmental planning
- …

TIMELINE OF COLLABORATION

- 1990-2008 Sustainable Cities Programme
- 2008-2013 Urban Environment Partnership Framework
- 2014-now Greener Cities Partnership
- 2016-now Monitor urban environmental SDG indicators
- 2017-now Main umbrella at UN for urban environmental programs

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RECENT EXAMPLE OF COLLABORATION (2016-17)

Greenbelt development in Chengdu, China

- Provide expertise to the ecological redevelopment plan
- Assess the master plan for the 198 km² urban greenbelt, and design

wetlands, bicycle paths, leisure walks, sport and recreation facilities

- **EAs**: better ecological protection, urban design, resource-efficiency, sustainable lifestyles, tourism, historic

preservation

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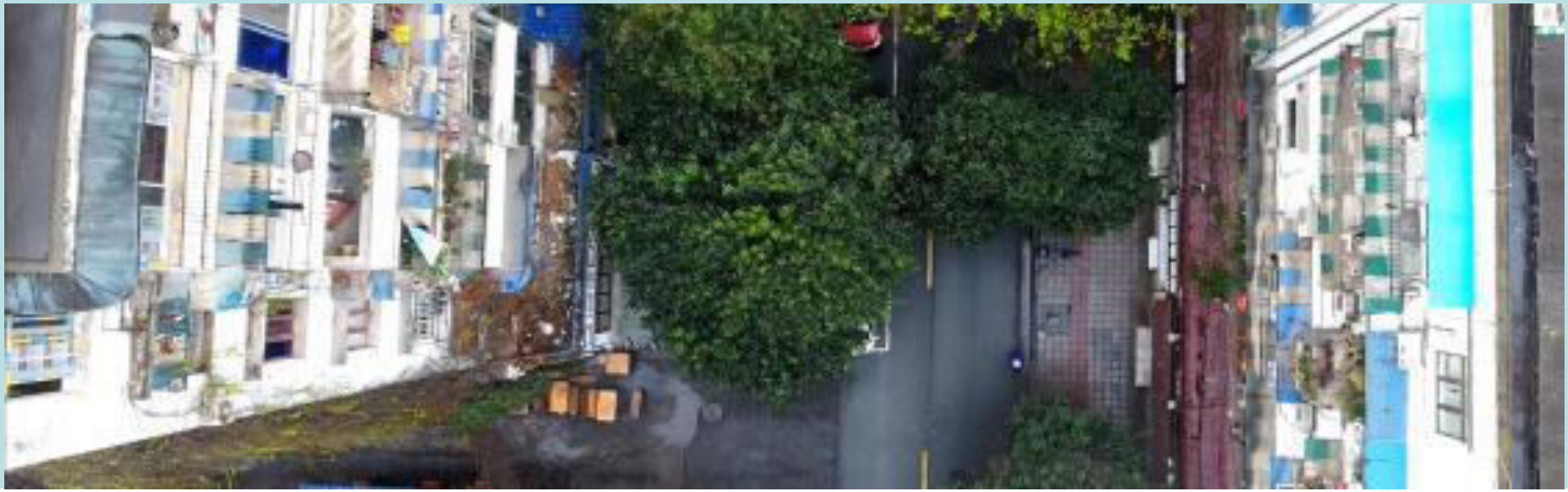
TIMELINE OF THE URBAN ENVIRONMENT AT THE UN

- 2008: Urban Environment Partnership Framework (UNH/UNEP)
- 2012: Rio+20, Global Initiative on Resource-Efficient Cities
- 2014: Greener Cities Partnership
- 2015: Paris Agreement (COP21)
- 2015: Agenda 2030 (SDGs)
- 2016: New Urban Agenda



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THE 2030 AGENDA & GREENER CITIES PARTNERSHIP

City-level action encompasses many more areas than Goal 11

SUSTAINABLE DEVELOPMENT GOALS

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GREEN INFRASTRUCTURE

Trang Nguyen
UN-Habitat
Trang.Nguyen@un.org

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,

This is **Marcus** and **Abdulaziz**

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

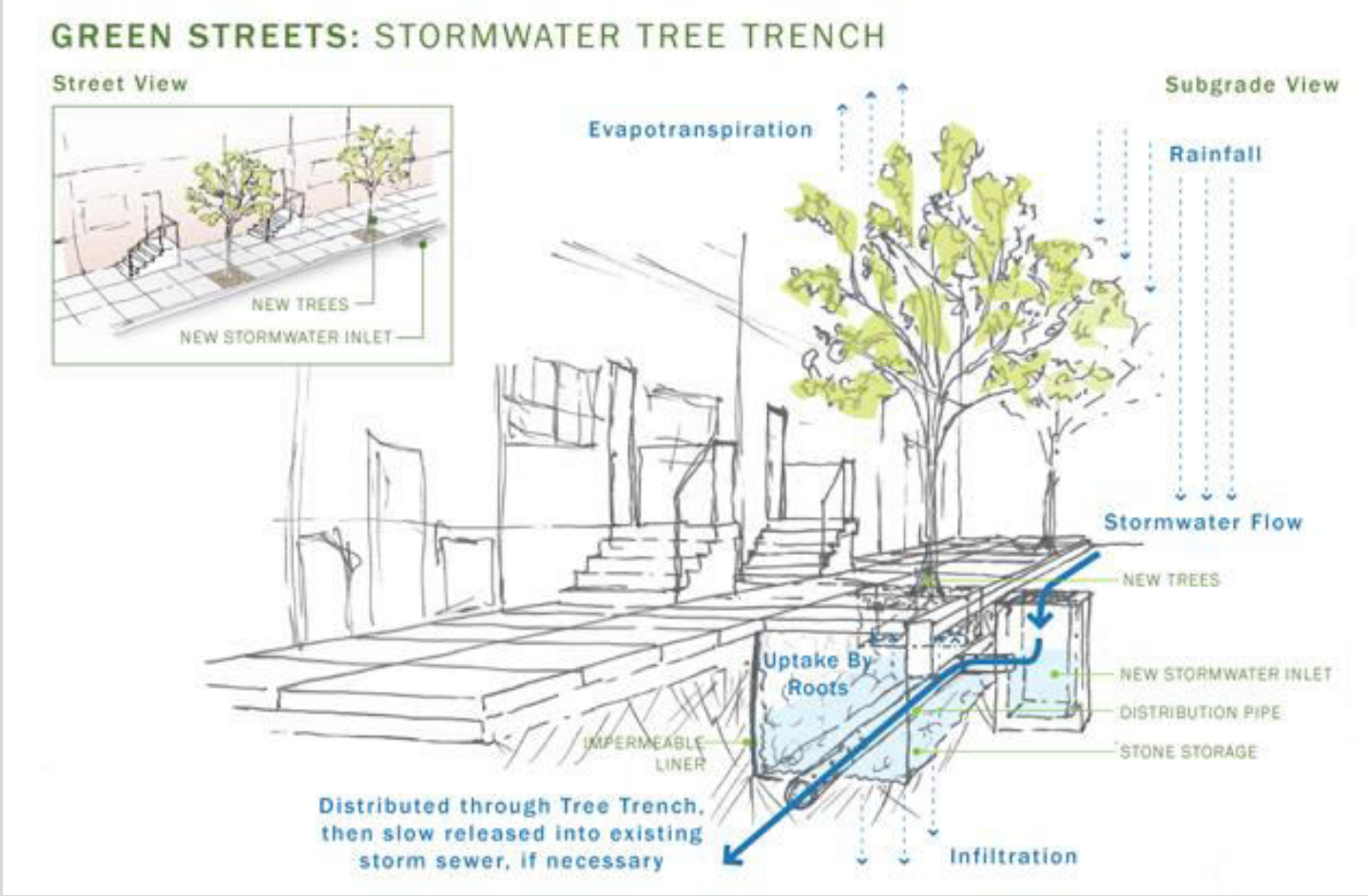
Green city

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

Source: Wilson, 2017

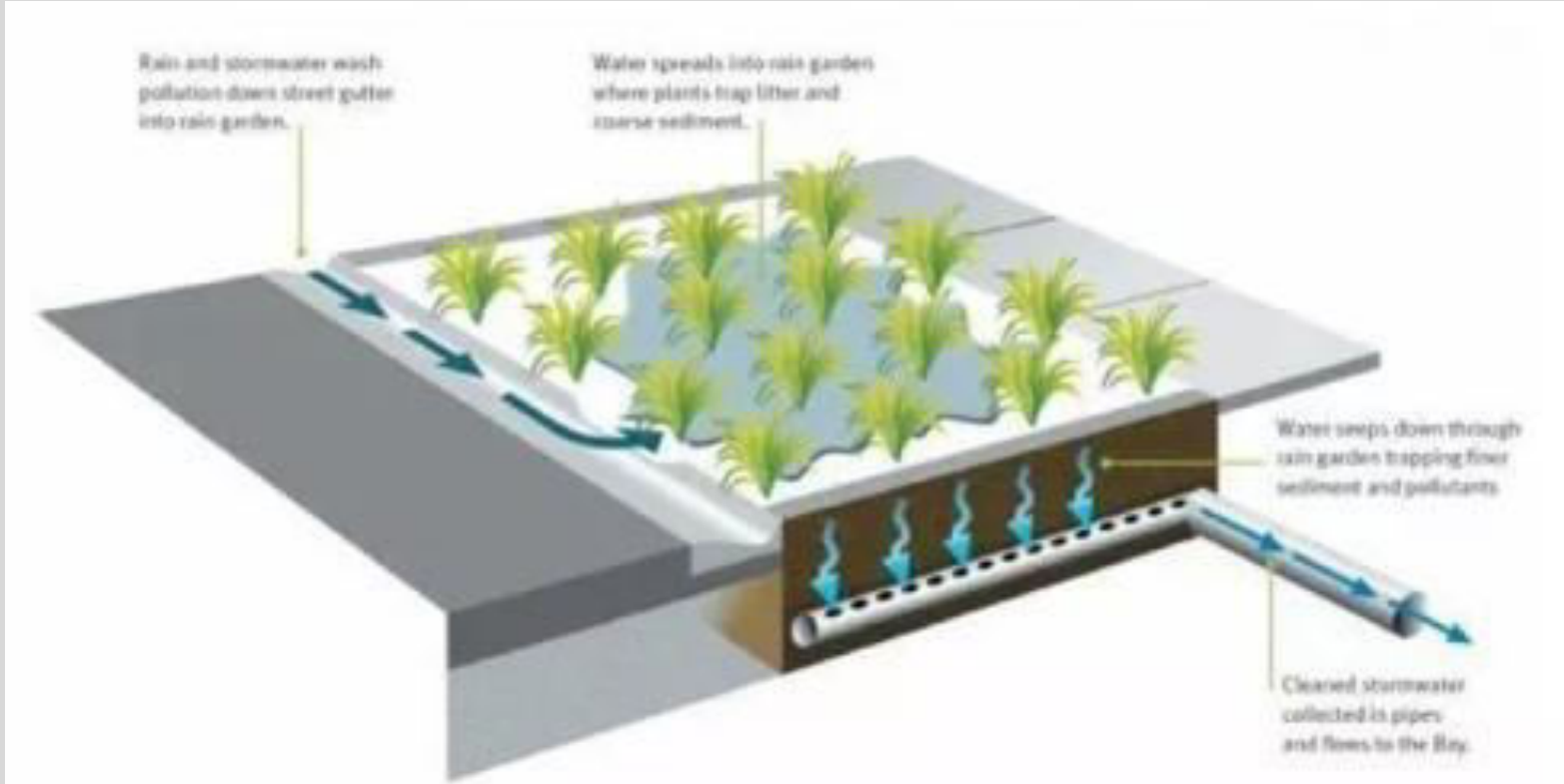
Tree Pits/ Retention Cells

- ✓ 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
- ✓ Weight –> need reinforcement

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

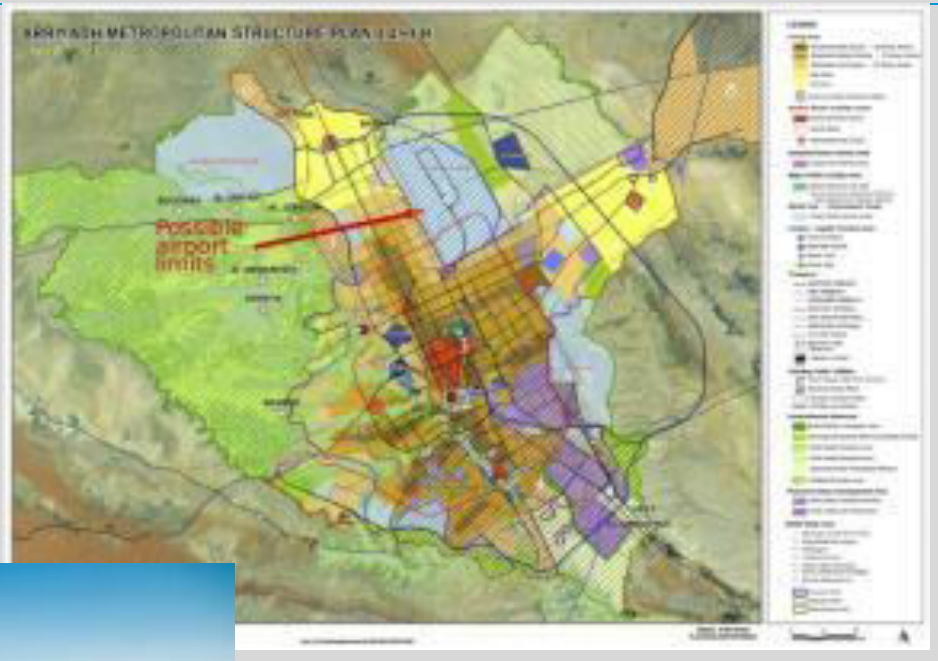
‘Daylighting‘ Rivers

- ✓ 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,

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

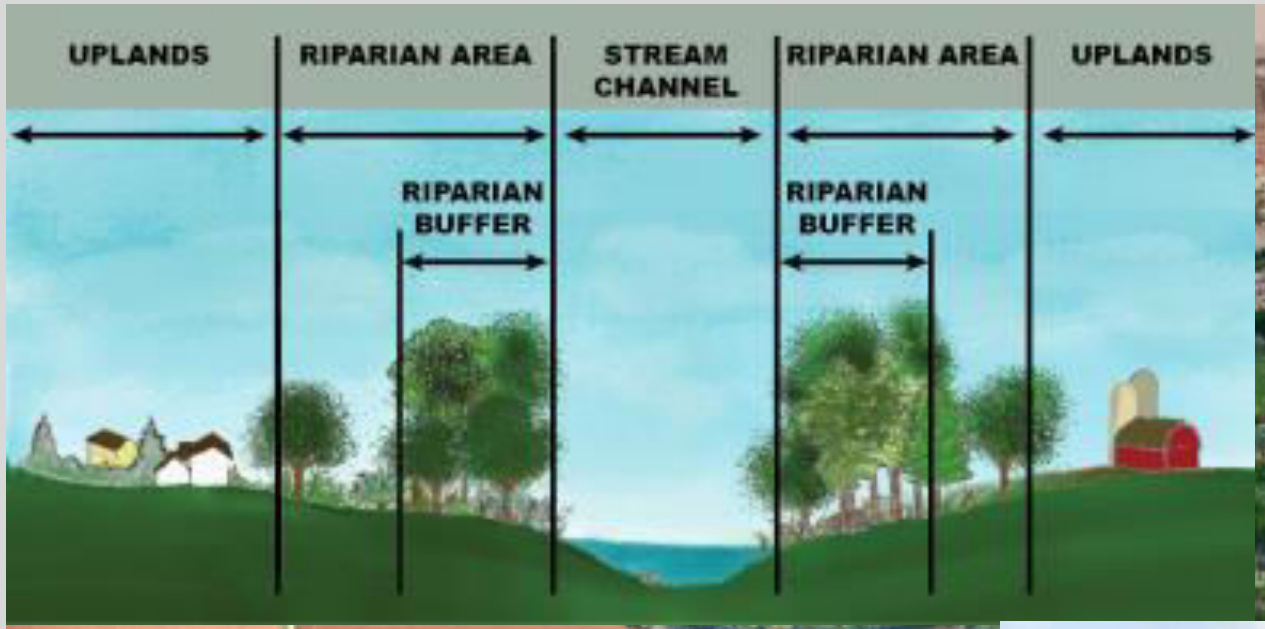


Mangrove – wetland restoration

- 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

Urban Forest - Urban Farming

Riparian Buffer Zones, Ecological Parks and Green Park Connectivity



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

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.

Energy (concept, design, installation, audit…)

Water (harvesting, efficiency, filtration)

Waste water (recycled wate)

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 building is also known as a sustainable or high performance

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.
- An appreciation for the modern look of the city has emerged.

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?

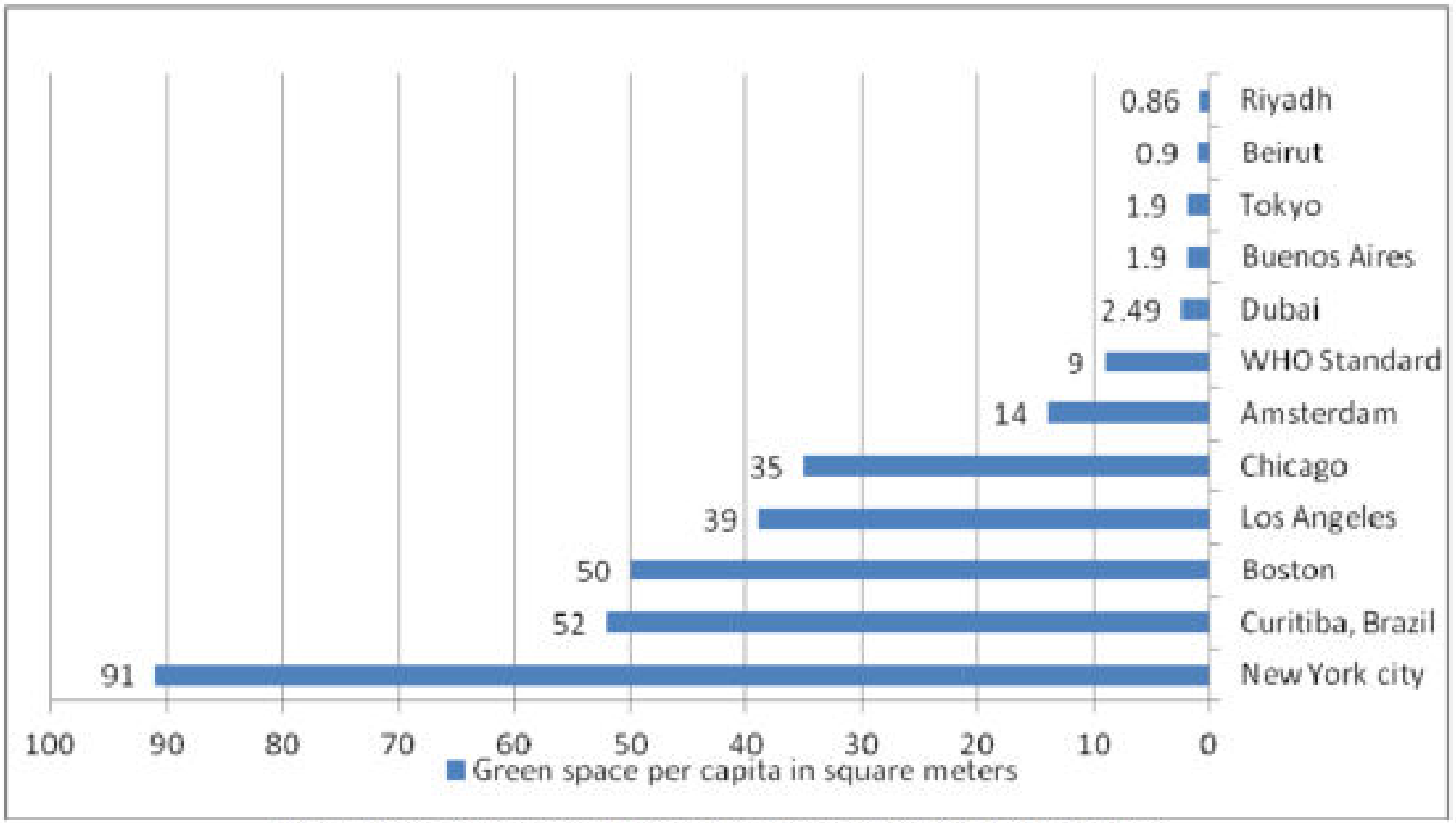


Fig. 1. Green space per capita in selected cities (prepared by the author).

Source: Almayouf 2013

Examples of gardens and green public space







e:
ouf 2013

GROUP WORK

Greening Riyadh City – Taking action !

Form 3 groups

Based on the discussions of previous days and:

1. Identify at least 3 potential interventions of GI for Riyadh
2. Discussion what are their co-benefits (CC adaptation, CC mitigation, environment, resource efficiency, economic, social etc.)
3. Prioritize and choose **the most** beneficial and feasible intervention
4. Draw an implementation plan, including:
   - Vision/goal
   - Steps/tasks
   - Location
   - Timeline
   - Involved stakeholders
5. Or Writing a Terms of Reference (TOR) for recruiting technical assistance team