

### **Cities Transformation**

**IIASA-Japan Joint Research Project** 

Keywan Riahi and Leila Niamir International Institute for Applied Systems Analysis (IIASA)

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### **International Writing Team**

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# Why Cities?

#### Sections 2 and 3

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### **Trends in urbanization**

The world is expected to be 63% urban in 2035 (up from 56% in 2020)

Urbanization interacts with land, energy, resource use, infrastructure, and socio-behavioral aspects, and is thus **critical for planetary sustainability** 

Urban systems were responsible for about **29**  $GtCO_2eq$  in **2020** and are increasing

Waste and air pollution remains major challenge in many mega-cities

### **Informal urban settlements**

#### **Major priority**

Informal settlements and slums, despite their high vulnerability to climate impacts, continue to be **overlooked in urban planning**.

Enabling the provision of **clean energy access in urban informal settlements offers multiple benefits** 







### **Climate impacts and vulnerability**

*Cities <u>provide</u> resilience, but also <u>exacerbate</u>, the impacts of climate change* 

### Providers of resilience and robustness

- efficient and economic provision of infra. services
- redundancy of infrastructure and services
- social infrastructure
- early warning systems and first responders
- blue & green spaces
- smart city planning

Cities have <u>absolute</u> and <u>relative</u> hotspots of vulnerability

#### Drivers of vulnerability

- poor governance, communication, preparedness and response
- high inequalities
- concrete jungles
- pollution
- high density
- few basic services





### **Urbanization typologies**

Typologies have emerged as a way of **clustering urban areas according to, eg, urban design, and development context**.

- **Urban growth patterns**: emerging, rapidly growing, and established urban areas
- **Urban form**: compact and walkable or dispersed and auto-centric urban areas
- Physical geomorphology and vulnerabilities: settlement type, impacts and resources



We are lacking urban typologies that integrate **both mitigation and adaptation perspectives**.





Source: IPCC (2022)

### Systems transformation iStock

#### Sections 4

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Credit: RoschetzkylstockEhoto

### Energy, land, water and food Spatial planning and urban form

- Cities are the centers of demand with the highest energy density and efficiency (challenges but also opportunities)
- **Urban form** and development largely determines energy demand opportunities
- Deep transformation needs to include institutional/market change to modify energy demand patterns, technological choices, and supply arrangements.
- (peri-)Urban food production (community-based agriculture) and increase of urban green infrastructure (landscape diversification) can mitigate the climate risks.
- Inclusive decision-making inviting indigenous people and local communities, as well as the most vulnerable, to ensure that all local people have adequate access to human basic needs and services.



#### Regional climate impacts, other shocks

- The future impacts of climate change increase to high risk between 1.5 °C to 2.0°C (with high confidence) (IPCC 2022).
- Cultural and heritage aspects
- Impacts of new technologies and its applications

#### Case study: Bhutan, climate change risks increase (glacier runoff)



Source: IIASA-MOEJ project B (Kamei et al) presented at IAMC, 2023





- Urban design and spatial planning critically shape sustainability of cities and demand of resources
- Buildings play a key role in the decarbonization of cities while being crucial in supporting human activities and wellbeing.
- Consider **the whole life-cycle of buildings** to reduce the demand for energy, materials, and resources.
- Demand-side strategies, such as Avoid, Shift, and Improve, offer significant mitigation potential by 2050, alongside co-benefits like improved health and job creation.



Source: Retrofit Or New Build? (forbes.com)



### Transport

- Only a fraction of current vehicle fleet is needed in cities to provide a better mobility service (ownership → usership & public transport)
- Efficient and accessible public transportation systems promote higher life quality standards and reduce externalities (congestion, pollution, social space)
- Low-Emission Zones can make a significant contribution to sustainable mobility.
- Urban freight decarbonization can adopt efficient last-mile delivery solutions (such as electric cargo bikes and consolidated delivery routes), reduce congestion and space consumption, and minimize emissions.
- Tailoring strategies to **each city's specific needs and characteristics** is essential and requires a holistic approach (planning, technology, policy, and community engagement).



Source: NetZeroCities



Energy intensity use in private passenger transport relation with urban density. Source: (Newman 2014)



### **Smart cities and digitalization**

"Smartness" of Cities will critically determine their CO2 emissions footprint:

- Moving from autonomous devices to digitally connected systems
- Increased efficiency and quality of service
- Vehicle electrification & digital RE integration (e.g., wireless power transfer, digitally optimized device use to integrate RE).
- Vehicle sharing and Mobility as a Service: Mixed findings on emissions.
- Autonomous vehicle: Enormous potential to transform urban form and design. There are optimistic and pantheistic perspectives.

#### Big data and AI methods:

 Useful to simulate what may happen after of the introduction of smart technologies under scenarios, considering multiple observations on people behavior and environment.

#### **GIS visualization:**

- Detailed CO<sub>2</sub> mapping based on big data (remote sensing, GPS,...).
- Digital twin environment will contribute to help clarify the current situation and progress of decarbonization.



 $CO_2$  mapping in Sumida, Tokyo



## Enabling Conditions

#### Sections 5

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### **Governance and institutions**

Cities are part of a multilayer governance system Governance needs to be inclusive, transparent and empowering Not one governance systems for all cities (informal settlements) Urban-rural partnerships;

### Social and technological innovation

#### Cities are hubs of innovations

Facilitate **global transformation** through their distinct support for experimentation effects, and international connectedness

### Finance

#### Enhanced availability and access

E.g, Public-private partnerships, and new innovative mechanisms to reach vulnerable groups



### **Behavioral and lifestyle changes**

#### Demand-side management

- individual behavioral and lifestyle changes
- Social norm
- Enabled by infrastructure and technologies

Significant potential

- climate change preparation and response
- rapid mitigation and multiple co-benefits
- altering urban forms
- designing infrastructure and providing services
- improving knowledge and awareness,
- investing in and utilizing renewable technologies
- implementing effective feedback mechanisms



Mitigation potential of demand-side options by 2050. Source: Creutzig, Niamir, et al. (2022) Nature Climate Change



### Synergies Sections 6

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**Credit: Halfpoint** 

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### Synergies across mitigation & adaptation and the SDGs

# Cities have many opportunities for **mitigation/adaptation synergies**

(expanding green spaces, building design, etc..).

#### Numerous opportunities for SDGs:

- New urban design and shift to public transport;
- Health benefits of active transport;
- Nature-based solutions (climate + recreational);
- Improved floor space use (social);
- promoting plant-based diets;
- switching to renewable energy;

SDG co-benefits need to become **priorities** of urban/climate planning, leading to improved **quality of (good) life** 

#### Niigata City, Japan Global Warming Action Plan 2018





# Thank you!

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