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Sustainable and Inclusive Cities: Crash Course

Sept 2025
Instructor: Janice Levenhagen

Women STEM UP Project Number: **2022-1-SE01-KA220-HED-000086239**

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NTNU Norwegian University of Science and Technology
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Agenda

6:00-6:05	5 min	Introduce instructor + agenda
6:05-6:15	10 min	*Discussion:* What issues do cities struggle with?
6:15-6:20	5 min	*Quiz:* Why is this important?
6:20-6:30	10 min	*Discussion+video:* What is a sustainable city?
6:30-6:35	5 min	*Video:* Inclusive cities
6:35-6:45	10 min	*Discussion:* What is an inclusive city?
6:45-6:53	8 min	*Definition:* Smart cities
6:53-7:00	7 min	*Video:* Drawbacks of smart cities

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Who am I?

- Computer engineer turned gender equity in STEM and entrepreneurship
- Left tech due to harassment and bias–very passionate about changing that for other women
- Launched and ran a nonprofit for girls and women in tech in the US for 8 years. 20+ cities, serving 8,000 people per year with 1,500 volunteers
- Now I do consulting for organizations serving women and girls, work on EU projects like this, and run a nonprofit called Wevise (wevise.org) around mentorship in tech

Photo by Todd Kulesza, ChickTech, Flickr, used with permission

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What issues do cities struggle with?

Informal settlements

Air pollution

Traffic congestion

https://www.context.news/socioeconomic-inclusion/worlds-slum-populations-set-to-surge-as-housing-crisis-bites
Screenshot taken May 11, 2025

https://time.com/9802/beijing-air-pollution-nuclear-winter/
| Screenshot taken May 11, 2025

https://www.freepressjournal.in/mumbai/mumbai-traffic-jams-hit-city-roads | Screenshot taken May 11, 2025

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Inaccessible public spaces

Poor waste management

Urban sprawl

The Dublin Shield
THE VOICE OF DUBLIN YOUTH

Keep it Inclusive – The Lack of Accessibility within Community Spaces

Kori Velasco, Staff Writer | January 25, 2023

Over the past few decades, monumental technological advances have been made in the field of medicine and disabilities. However, despite this progress,

https://thedublinshield.com/uncategorized/2023/01/25/keep-it-inclusive-the-lack-of-accessibility-within-community-spaces/ | Screenshot taken May 11, 2025

Office of the President of the Philippines
CLIMATE CHANGE COMMISSION

Ridge to Reef: The Fight Against Mismanaged Waste

September 09, 2024 Monday

Photo by: Albert Alcain

https://climate.gov.ph/news/923 | Screenshot taken May 11, 2025

yahoo!news

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News Latest National World Environment Sport

Kamilia Palu · News Editor
Updated Fri 9 May 2025 at 5:35 am GMT+2 · 6-min read

Monash experts Professor Louise Wright and Associate Professor Catherine Murphy (pictured) say Melbourne's urban sprawl has come at a great cost to habitat and biodiversity. Photo: Nigel Bertram

https://au.news.yahoo.com/photos-show-huge-problem-facing-australias-fastest-growing-city-such-a-high-price-033547779.html | Screenshot taken May 11, 2025

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Inequitable transport systems

GREENPEACE

Issues we work on | Get involved | News & Stories | About us

Inequality and transport: who decides where you go?

Nerea Ramírez Piris
20 September 2023 • 3 min read

Transport systems are typically designed for men, and service the journeys they want to make. This is especially true for middle-aged, white, cis-male, able bodied, wealthy men. If you don't fit this description, transport might not serve your daily needs.

Copenhagen, Denmark. In some cities, cycle paths are also accessible for people using wheelchairs or mobility scooters to get around, enabling people living with and without disabilities to join in social rides. © Chris Grodotzki / Greenpeace

https://w inequality-and-transport-who-decides-where-you-go/ | Screenshot taken May 11, 2025

Heat islands/lack of green space

SciDev Net — Bringing science & development together through news & analysis — Menu

Home / News

17/04/25

Urban heat islands 'increasing faster' in poorer cities

A section of Cairo city at sunset. A new study published in the journal Urban Sustainability indicates that urban areas are heating up at an average rate of 0.021 degrees Celsius per year. Copyright: Matt Wan (CC BY-NC-ND 2.0)

https://www.scidev.net/global/news/urban-heat-islands-increasing-faster-in-poorer-cities/ | Screenshot taken May 11, 2025

Flooding due to inadequate infrastructure

South China Morning Post

Indonesia | This Week in Asia / Health & Environment

Jakarta's floods worsen, displacing thousands as extreme weather, poor planning collide

Extreme weather and poor urban planning have exacerbated Jakarta's annual flooding, displacing residents and highlighting critical infrastructure failures

Reading Time: 3 minutes

Resty Woro Yuniar

Published: 8:27pm, 11 Mar 2025 | Updated: 9:12pm, 11 Mar 2025

https://www.scmp.com/week-asia/health-environment/article/3301976/jakartas-annual-floods-worsen-displacing-thousands-extreme-weather-poor-planning-collide | Screenshot taken May 11, 2025

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Why is this important?

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What percentage of Earth's land do cities occupy?

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What percentage of the world's population lives in cities?

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How much energy do cities consume?

By 2050, how many people are expected to live in slums?

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What is a sustainable city?

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ENVIRONMENT
SOCIAL
ECONOMY
ECOLOGICAL
HUMAN NEEDS
DURABILITÉ
TRIPLE BOTTOM LINE

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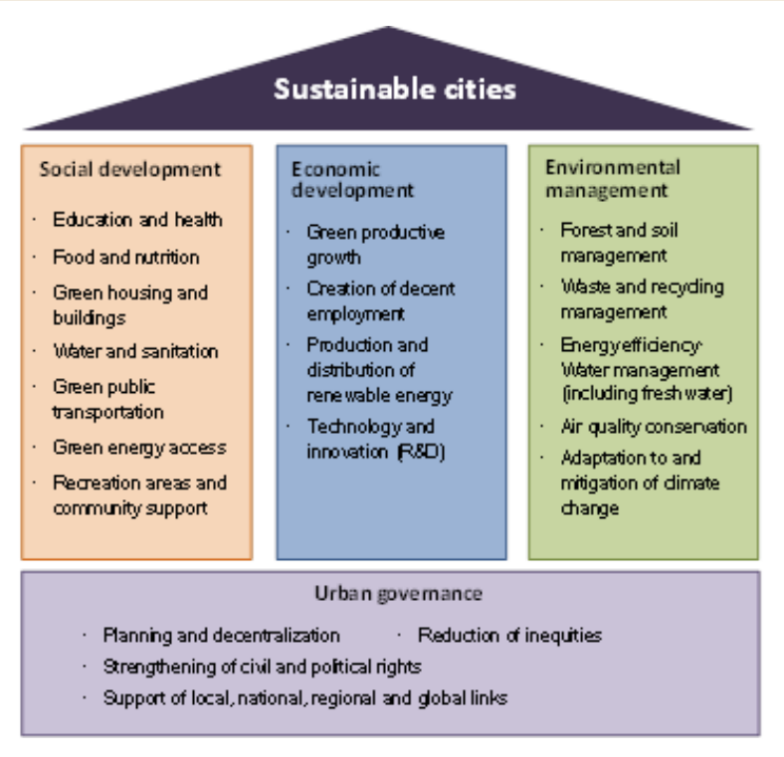

https://sustainabledevelopment.un.org/content/documents/2948chairsummaryside2.pdf

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SDG 11:

Make cities and human settlements inclusive, safe, resilient and sustainable

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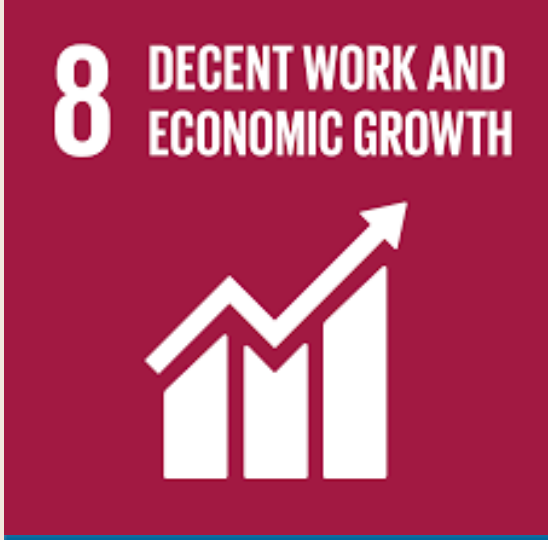
ALSO

- SDG 8: Promote sustained, inclusive, and sustainable economic growth
- SGD 16: Promote peaceful and inclusive societies for sustainable development



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Inclusive Cities

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What is an inclusive city?

- What could cause different experiences between different people?
- What ARE “different” people? Different from who?
- What might those different experiences look like?

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Who is affected differently by cities?

Sexual Orientation/ Gender Identity

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Why is it important for a city to be inclusive?

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Smart Cities

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Smart cities…

Use data and digital technologies (IoT, sensors, AI) to improve urban services like traffic, energy, and public safety. Focus is on efficiency, connectivity, and innovation.

Cognitive cities…

Go further by incorporating machine learning and adaptive systems that learn from residents' behaviors and predict needs. Emphasis is on anticipating change and human-centric adaptation.

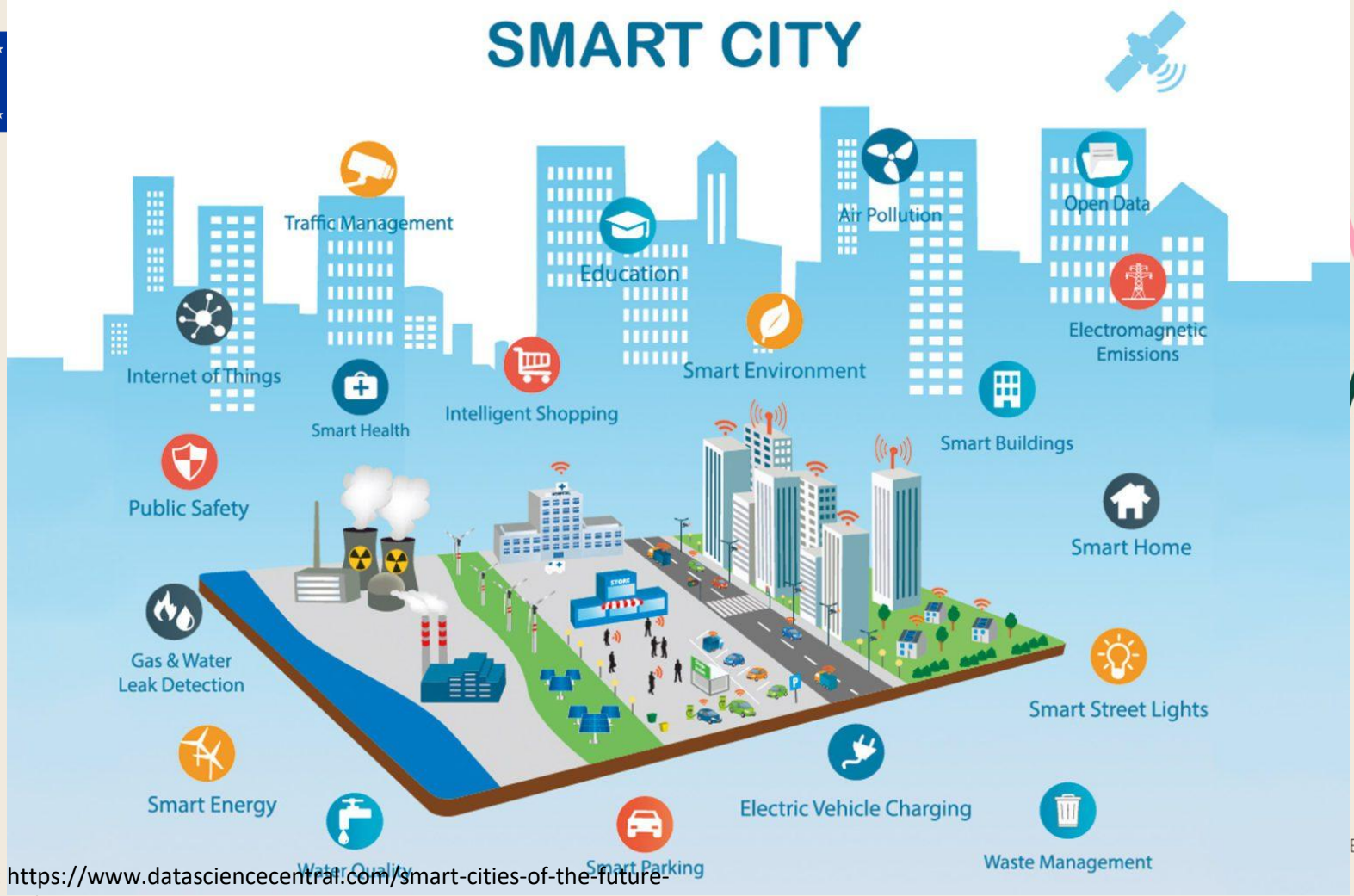

Photo credit: https://www.datasciencecentral.com/smart-cities-of-the-future-powered-by-iot/

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The tech

IoT	network of devices that connect to each other and the cloud
5g	the network that allows a lot more people/devices to send much more data with much higher speed and lower latency (allowing for near real-time)
Big data	all of the data created by sensors, people, weather satellites, etc. Includes structured, semi-structured, not structured
Blockchain	secure, private, and transparent way to transmit data
AI	the ability to “think” about all of this information in a way that allows for predictive analysis
Edge computing	the computing is done in the local area/device so that the data doesn’t need to be sent to a central “cloud” for processing

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Example: Traffic Optimization System

To reduce congestion, cut emissions, and improve emergency response times

IoT (Internet of Things)
→ Smart traffic lights, cameras, pollution monitors, and connected vehicles continuously gather real-time data (vehicle counts, speed, weather, air quality, road conditions).

5G
→ Enables real-time data exchange between IoT devices, vehicles, and traffic control centers. Emergency vehicles can instantly communicate with traffic lights to prioritize green signals.

Big Data
→ The system collects and processes data from thousands of sensors and external sources (e.g. weather forecasts, public transport GPS feeds) to understand patterns and predict traffic flows.

AI (Artificial Intelligence)
→ AI models analyze incoming data to adjust traffic lights dynamically, reroute traffic during accidents or construction, and predict congestion before it happens.

Blockchain
→ All data interactions (like vehicle location updates, traffic light changes, or ride-sharing transactions) are stored securely and transparently. Blockchain also helps in managing microtransactions—for example, rewarding citizens with crypto-tokens for using less congested routes or public transport.

Edge Computing
→ Reduces latency and bandwidth usage by processing critical data (like traffic camera feeds) locally rather than sending everything to a central cloud.

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What issues might there be with this kind of technology?

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People/Inclusivity

- Technocentrism over human-centered design
- Digital divide
- Surveillance and privacy (& social engineering)
- Algorithmic bias
- Public participation gaps
- Gentrification and displacement
- Labor and human rights issues in tech supply chains

Environment

- Greenhouse gas emissions
- E-waste and resource extraction
- Energy consumption of smart infrastructure
- Greenwashing and token sustainability
- Climate resilience gaps
- Water use and pollution from tech infrastructure
- Greenhouse gas emissions from tech operations and supply chains

Technology

- Bugs and inaccuracy of algorithms
- Data accuracy (and “overfitting”)
- Security vulnerabilities
- Interoperability challenges
- Over-reliance on technology
- Cost and vendor lock-in

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Good luck!

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Some facts (the bad)

- Less than 10% of the Paris metro network is wheelchair accessible
- In Dhaka, Bangladesh, a city of over 23 million, less than 2% of roads have proper pedestrian infrastructure, disproportionately affecting children, the elderly, and people with disabilities.
- In LA, wealthier neighborhoods have up to 42% tree canopy coverage, compared to just 10–15% in low-income areas, worsening urban heat for already vulnerable populations.
- According to UN Women, 99.3% of women in Cairo report experiencing sexual harassment in public spaces, a major barrier to gender-inclusive mobility and participation in city life.
- About 70% of Lagos's 20+ million residents live in informal settlements or slums with limited access to water, sanitation, and transport, despite the city's massive economic growth.
- In São Paulo, low-income residents from peripheral areas often spend over 4 hours a day commuting, largely due to poor transit access and urban sprawl — reducing time for education, caregiving, and community life.

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Some facts (the good)

- Paris plans to expand its bike lane network to over 1,000 km by 2026, prioritizing mobility for non-drivers and reducing transport inequality, particularly for women and young people.
- Over 3,000 cities globally (including New York, Paris, and Porto Alegre) now use participatory budgeting, allowing residents—especially marginalized groups—to directly influence how public funds are spent. In Surabaya, Indonesia, 50% of its annual municipal budget is allocated to local community projects
- Around 60% of Vienna's population lives in city-owned or subsidized housing, helping prevent gentrification and keeping neighborhoods mixed and accessible across income levels.
- The Metrocable system in Medellín reduced commute times for hillside residents by 40%, providing affordable access to jobs, education, and healthcare for low-income communities.
- In Barcelona, car traffic dropped by 25% in areas where superblocks were implemented, giving more space to pedestrians, kids, and disabled residents while reducing air and noise pollution.
- Kigali (Rwanda) implemented a citywide safety code for public transport, including complaint hotlines and driver accountability, contributing to a reported 35% drop in harassment cases on buses within the first year.
- To combat heat and flooding, Freetown launched a "Freetown the Treetown" initiative, planting 500,000 trees by 2023 with resident involvement, improving resilience and equity in informal settlements hit hardest by climate change.

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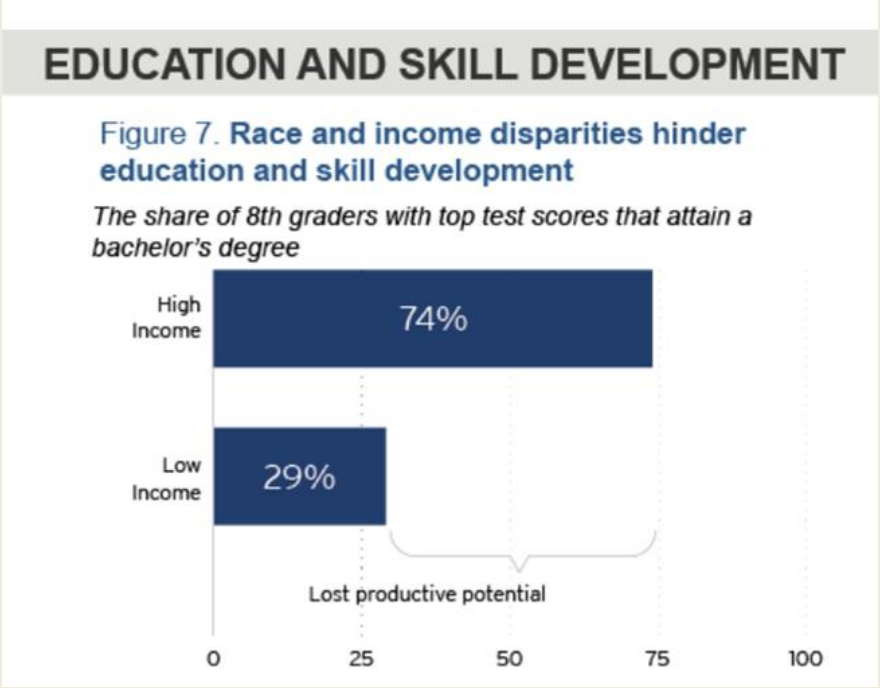
Case study: the cost of unequal economic opportunity



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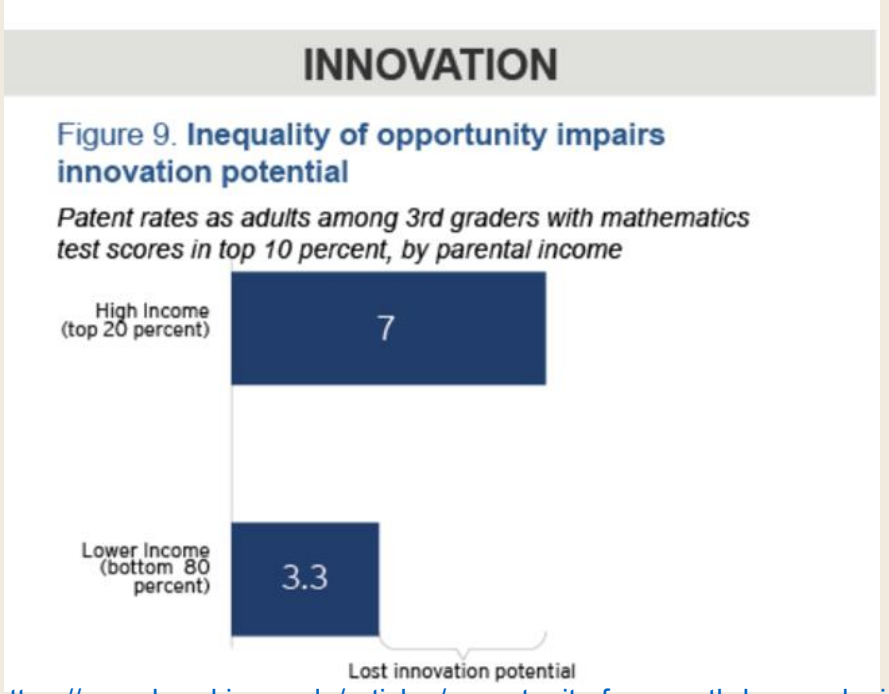
Case study: the cost of unequal economic opportunity



 https://www.brookings.edu/articles/opportunity-for-growth-how-reducing-barriers-to-economic-inclusion-can-benefit-workers-firms-and-local-economies/

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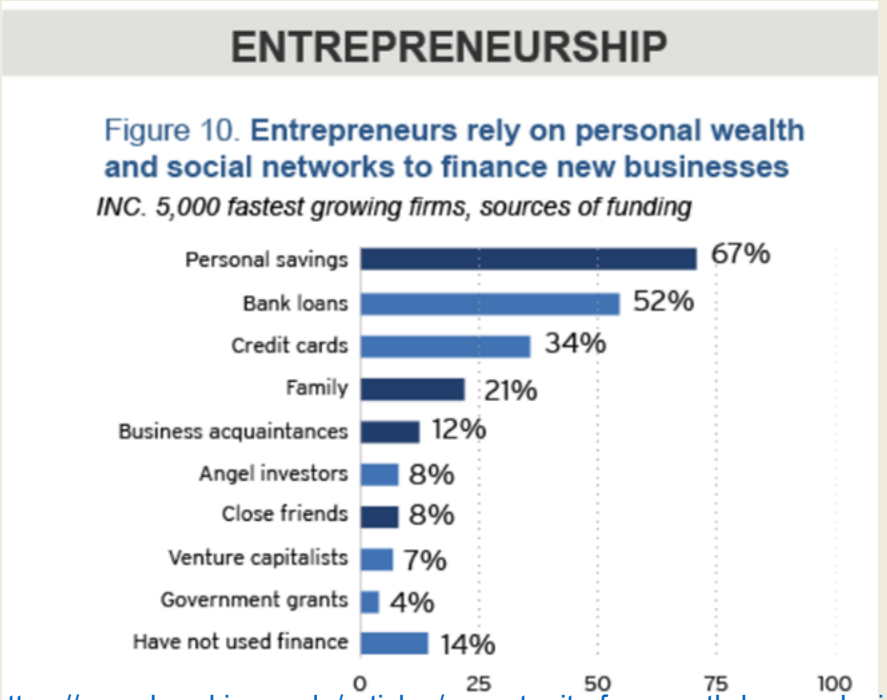
Case study: the cost of unequal economic opportunity



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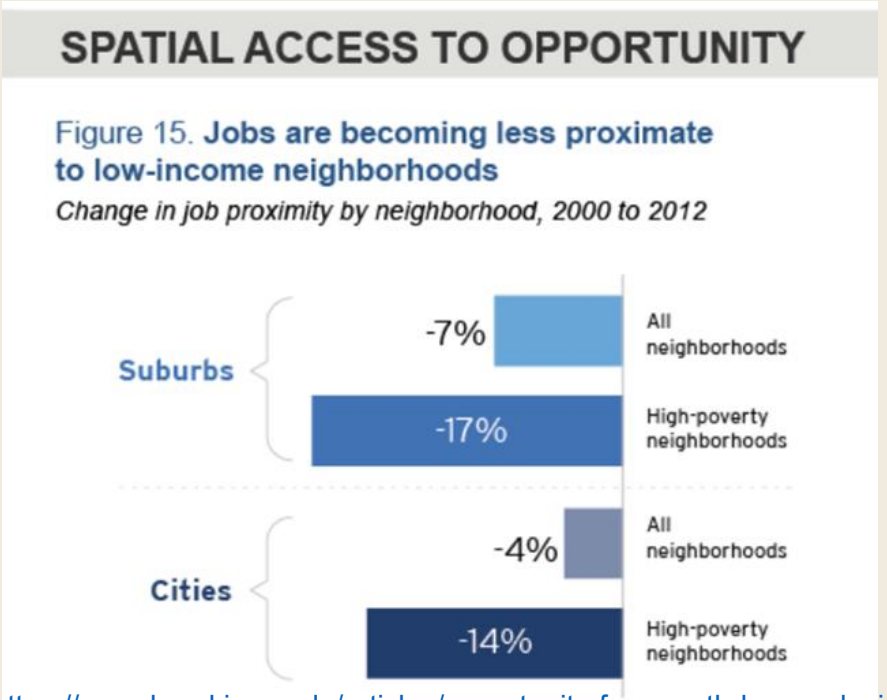
Case study: the cost of unequal economic opportunity



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Case study: the cost of unequal economic opportunity (cont'd)

- Childhood poverty (an outcome of insufficiently inclusive growth) costs the US economy ~$500bil per year–4% of GDP, due to lost productivity, higher crime and incarceration, and larger health expenditures
- Hostilities that fray social and political cohesion and good governance (which affects economic growth)

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UN Women

Safe Cities and Safe Public Spaces

Global flagship initiative to prevent sexual harassment in public spaces. Partner cities include Cairo, Quito, Port Moresby, Delhi, and Kigali.

Focus on:

- Ending violence against women
- Economic empowerment
- Leadership and governance
- Gender mainstreaming and institutional development

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Example: Women's safety audits

- Women and community members walk through neighborhoods to identify unsafe areas (poor lighting, lack of transport, overgrown areas, etc.)
- Originated in Toronto in the 1980's (METRAC–group of women who came together to fight against sexual assault and murder of women)
- Start close to dusk to see area during day and night
- Shows how participation of the groups affected is critical

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Case Study: Women's safety audits

Delhi, 2013

- 95% of women and girls in Delhi said they felt unsafe in public spaces
- 51% of men reported that they had themselves perpetrated sexual harassment or violence against women and girls in public spaces in Delhi. In the study, 25 per cent said they had done so in the last six months.
- In cases of sexual violence, many men blamed women for their behaviour. In the study, three out of four agreed with the statement 'Women provoke men by the way they dress' and two men out of five fully or partially agreed that 'Women moving around at night deserve to be sexually harassed'.
- Nearly 73 per cent of women said they do not feel safe in their own surroundings as well, and reported feeling unsafe all the time.

https://www.unwomen.org/en/news/stories/2013/2/un-women-supported-survey-in-delhi

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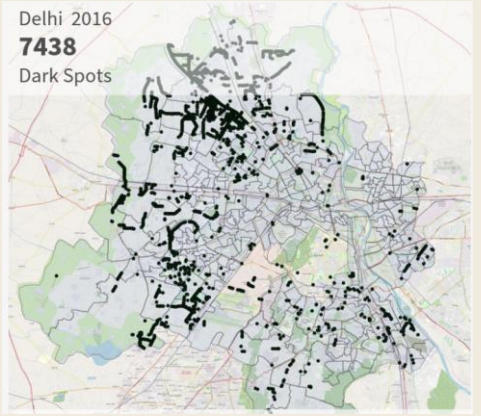
Case Study: Women's safety audits

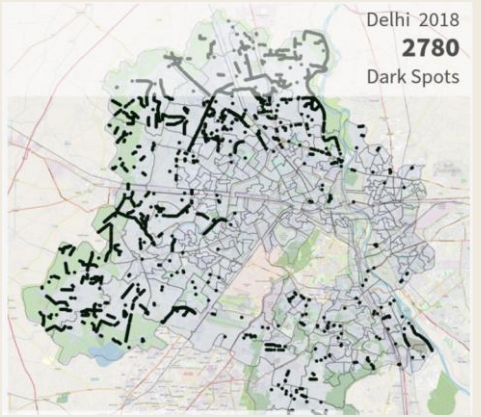
Findings

- Insensitive attitudes of the police and public transport staff including drivers and conductors
- Gaps in provision and effectiveness of essential services (access to telephone booths, police and 24-hour hospitals)
- Poor lighting near bus stops (and in general a need for more street lighting infrastructure)
- Lack of well-maintained public toilets
- Absence of pavement
- "Never before was violence against women considered an urban planning problem. But now more urban planners and policymakers are reviewing urban design – thanks to our programme," says Sushma Kapoor, Officer-in-Charge, UN Women.
- "The programme has really helped to make women an equal partner in ensuring their safety. Women are now able to speak of their experiences directly to the police, and tell us what is needed to be done," says Suman Nalwa, Additional District Commissioner of Police, Special Police Unit for Women and Children.
- source

Technology: Safetipin

SAFETIPIN ion
Supporting Safer Cities





Technology: Safetipin

- NGO created an app for crowdsourcing information on unsafe areas in towns, sharing that data with the public and governments so they can be addressed
- Launched in Delhi in 2013 but now in 16 countries and 78 cities, almost 600,000 audits
- Data used as inputs to where lighting could be improved, and the Delhi Police used it to reformulate their patrolling routes
- Digital Divide (poverty, gender)--
  - Worked with NGOs to hear the voices of marginalized people
  - Supported women working in groups so those without smartphones could participate (with others who did have them)
  - Provided posters with the information in different areas so residents could see and provide thoughts/feedback in person.

Study

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Steps

- Step 1: Inclusivity issues and potential fixes
- Step 2: Using technology focused on urban design to address one of the issues
- Step 3: Examining the environmental sustainability of the various options to solve the issues, with a final proposal with pros and cons

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Review: What's a smart city?


DW
Smart
Cities
SHIFT

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What examples have you seen in your daily lives or travels?

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Case studies

Potholes and smartphones (Boston)

- Smartphone app to discover potholes on public roads through automated recognition by the phone's accelerometer
- However, lower income (and particularly older) residents, had fewer smartphones (16%)
- Therefore, lower income areas that may have more potholes would get fewer resources to fix them.

https://www.sciencedirect.com/science/article/pii/S2515856220300067

Predictive policing (UK)

- Smart Information System (SIS): AI+Big Data
- 2023: 24.5 stops and searches for every 1,000 Black people, 5.9 for every 1,000 white people
- This biased data is then fed into the algorithms, which is in turn fed back to police

https://www.researchgate.net/publication/304746305_Privacy_concerns_in_smart_cities
https://www.amnesty.org.uk/press-releases/uk-police-forces-supercharging-racism-crime-predicting-tech-new-report

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“Racism has always been about predicting, about making certain racial groups seem as if they are predisposed to do bad things and therefore justify controlling them.”

Dorothy Roberts, writer and academic, University of Pennsylvania

Video: “Policing without the police: race, technology and the new Jim Code”

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AGAIN: must be people-centric and participatory!

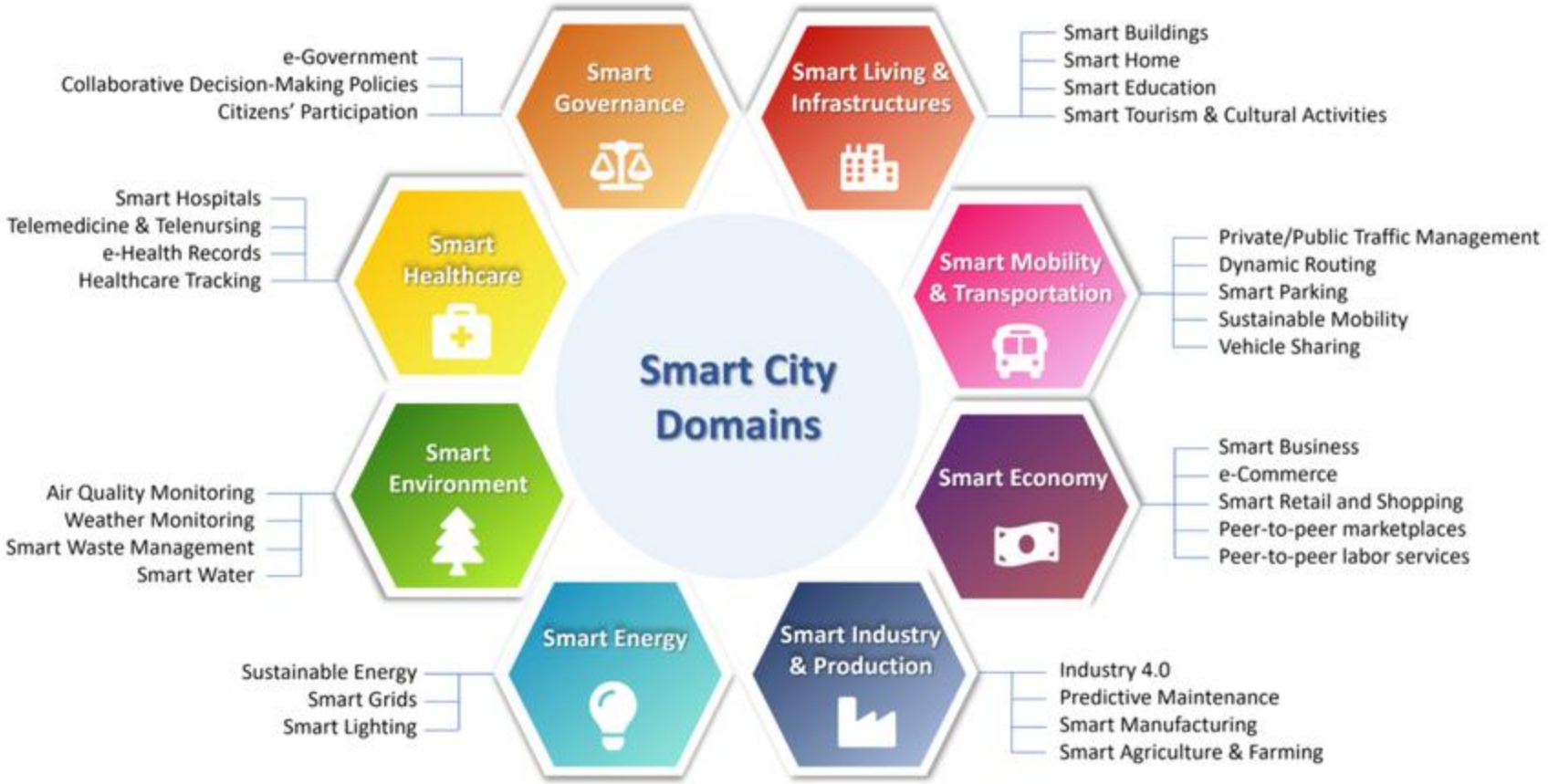

Image from: Bellini, Pierfrancesco & Nesi, Paolo & Pantaleo, Gianni. (2022). IoT-Enabled Smart Cities: A Review of Concepts, Frameworks and Key Technologies. Applied Sciences. 12. 1607. 10.3390/app12031607.

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https://bit.ly/sustainable-cities-folder

Group work:

How could you use technology to (partially) fix the inclusivity issue(s) you chose? Be specific!

What are the drawbacks? Is anyone left out?

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Agenda: Session 4 (Environmental sustainability and circular economy)

15 min	Introduction
5 min	*Video:* What is a circular economy/circular city?
10 min	Circular city case studies
10 min	*Quiz:* Critical thinking around environmental sustainability
10 min	Green cities + green spaces = healthier people
15 min	Small group discussions
5 min	Report out

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Review:What's a green city?

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An environmentally sustainable city (eco-city/green city), is an urban area designed and managed to meet the needs of its present inhabitants **without compromising the ability of future generations to meet their own needs** — with a specific emphasis on minimizing its environmental footprint.

Environmental sustainability in cities means ensuring that urban development:

- Reduces emissions and pollution (air, water, noise, and soil),
- Protects and regenerates ecosystems and biodiversity,
- Manages natural resources responsibly, especially energy, water, and land,
- Adapts to climate risks like floods, heatwaves, and droughts.

Cities are both the problem and the solution…most of the issues come from cities, but they are also where most of the innovation is coming from as well!


CREATING
SUSTAINABLE
CITIES

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Core environmental priorities for cities

- **Urban Decarbonization**: Transitioning to renewable energy, improving building efficiency, and reducing transport-related emissions.
- **Circular Urban Systems**: Designing out waste, reusing materials, and recovering resources (especially in construction and food).
- **Green Infrastructure**: Integrating natural systems into city planning (green roofs, urban forests, rain gardens).
- **Low-impact Urban Design**: Compact, mixed-use planning that reduces car dependency and preserves surrounding natural areas.
- **Climate Adaptation and Resilience**: Building infrastructure and governance systems that can anticipate and respond to climate shocks.

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Key challenges

- **Urban sprawl** and land-use pressure on ecosystems
- **Overburdened infrastructure** that increases emissions and waste
- **Inequitable environmental burdens** (e.g. pollution in marginalized neighborhoods)
- **Short-term political cycles** vs long-term sustainability investments

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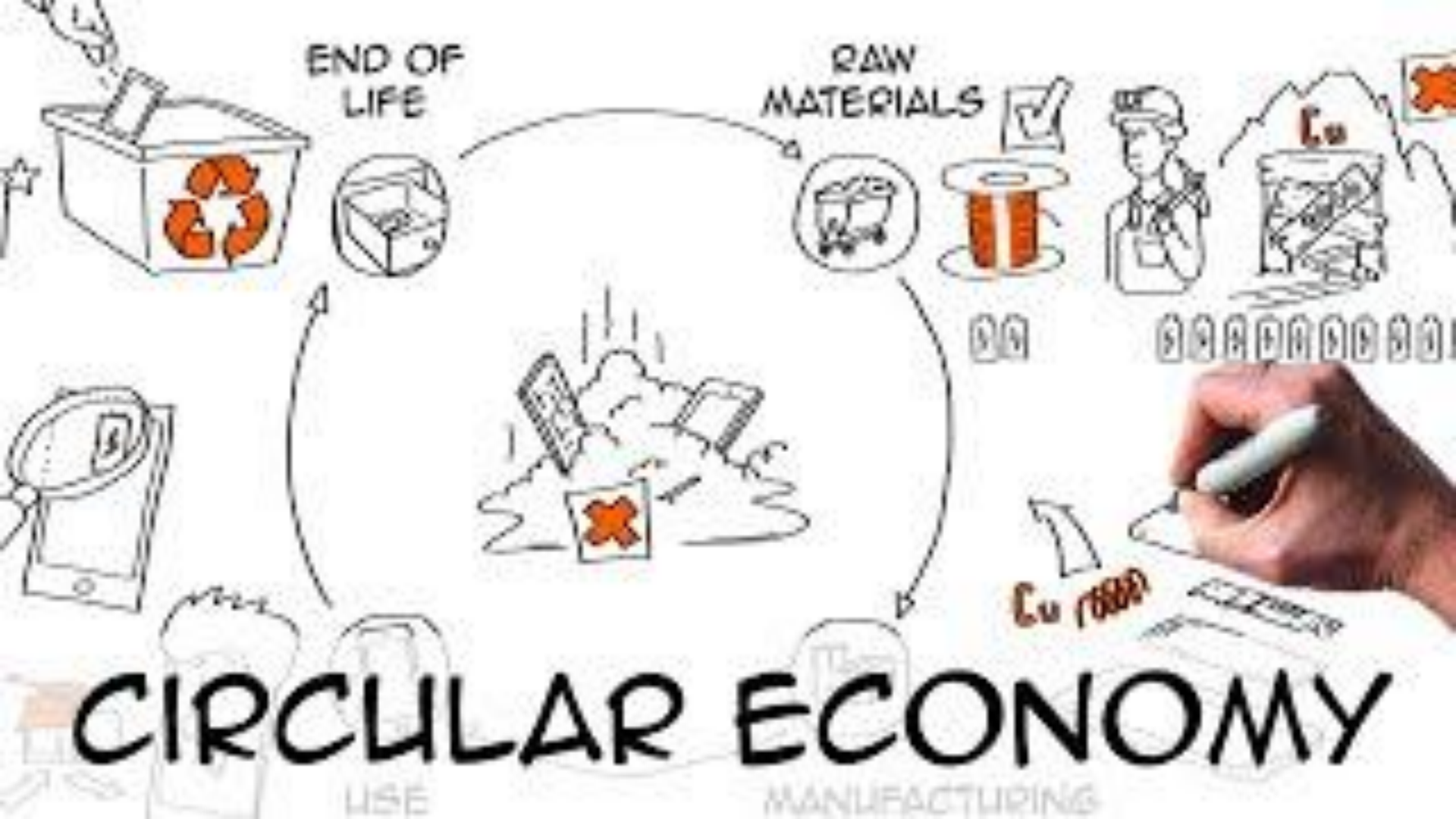
Example: Curitiba, Brazil

- Green space:
  - 52 square meters of green space per person
  - Vs Buenos Aires: 2 square meters per person
- Public transport:
  - Bus Rapid Transport (BRT). 1974. Basis for BRT systems in 300+ cities
  - 70-80% of daily trips for 85% of the population
  - Sometimes every 90 seconds!
  - 2 million per day (compared to London tube system with 3 million)
- Waste:
  - Waste-for-cash program
  - 90% of people take part
  - 4lbs of waste for tokens that can be traded for 1lb of produce.
  - 70% of the waste is recycled.
- Poverty reduction:
  - 30-year economic growth rate is 3.1 percent higher than the national average
  - Per-capita income is 66 percent higher.
  - Over the last 60 years, the population increased by 1,000% to 2 million people


Entrada
Sentido > Santa Cândida
BD106
HD221
REDENTOR
CURITIBA
PARCELE AQUI EM 5X
NOS CARTÕES
"SEM JUROS"
Estação
Central


END OF LIFE
RAW MATERIALS
CIRCULAR ECONOMY
USE
MANUFACTURING

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Circular cities: Case studies

Beijing Chaoyang Circular Economy Industrial Park

Clustering industries to reuse each other's byproducts

Electric Vehicle Charging and Battery Swap Station:

Serves sanitation vehicles, electric cars and Dongdong buses. Serves up to 400 vehicles daily.

Restaurant Kitchen Waste Treatment Plant:

Note: food waste is a huge issue in China (70% of waste is food waste, as compared to around 24% in US/Europe)

Largest kitchen waste treatment plant in China. Can process 400 tons of kitchen waste per day. A biochemical treatment technology with high-temperature aerobic fermentation allows to produce 'microbial inoculant' for organic agriculture.

Medical Waste Treatment Plant:

Daily treatment capacity of 30 tons.

Waste Incineration Power Plant:

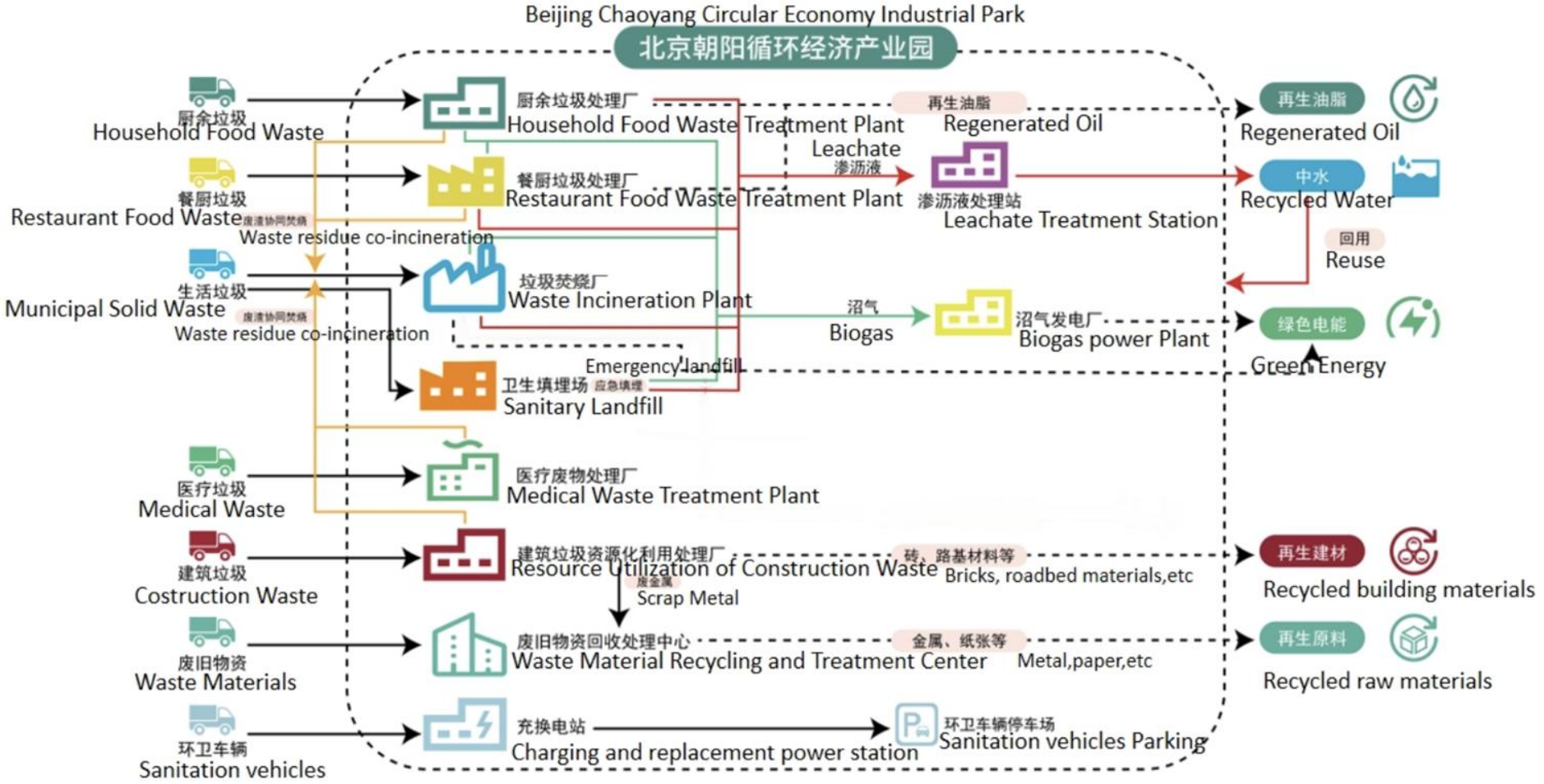
First modern large-scale domestic waste incineration project in Beijing, and also the largest single-line treatment plant in Asia.

Designed daily capacity is 1,600 tons. Annual rated power generation is of 220,000 MWh (about 73,000 houses in Beijing)

Sanitary Landfill:

First large-scale fully-enclosed domestic waste landfill in Beijing.

Total storage capacity of 8.92 million cubic meters and a daily waste disposal capacity of 1,000 tons.


Beijing Chaoyang Circular Economy Industrial Park
北京朝阳循环经济产业园
厨余垃圾
Household Food Waste
厨余垃圾处理厂
Household Food Waste Treatment Plant
再生油脂
Regenerated Oil
Leachate
渗沥液
再生油脂
Regenerated Oil
餐厨垃圾
Restaurant Food Waste
餐厨垃圾处理厂
Restaurant Food Waste Treatment Plant
渗沥液处理站
Leachate Treatment Station
中水
Recycled Water
废渣协同焚烧
Waste residue co-incineration
回用
Reuse
生活垃圾
Municipal Solid Waste
废渣协同焚烧
Waste residue co-incineration
垃圾焚烧厂
Waste Incineration Plant
沼气
Biogas
沼气发电厂
Biogas power Plant
绿色电能
Green Energy
Emergency Landfill
卫生填埋场 应急填埋
Sanitary Landfill
医疗垃圾
Medical Waste
医疗废物处理厂
Medical Waste Treatment Plant
建筑垃圾
Costruction Waste
建筑垃圾资源化利用处理厂
Resource Utilization of Construction Waste
砖、路基材料等
Bricks, roadbed materials,etc
再生建材
Recycled building materials
废金属
Scrap Metal
废旧物资
Waste Materials
废旧物资回收处理中心
Waste Material Recycling and Treatment Center
金属、纸张等
Metal,paper,etc
再生原料
Recycled raw materials
环卫车辆
Sanitation vehicles
充换电站
Charging and replacement power station
环卫车辆停车场
Sanitation vehicles Parking

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Benefits

Producing capacity of green power of 600 million kWh/year

Crude grease of 5,000 tons/year

Renewable resources and renewable products of more than 4,000 tons/day, reducing CO2 emissions by nearly 1.6 million tons per year

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Circular cities: Case studies

Cape Town, South Africa

WISP: Western Cape Industrial Symbiosis Programme

Connects businesses with each other to exchange resources!

231 synergies facilitated to date

- Diverted over 143,000 tons of waste from landfill and created over 400 jobs.
- Saved over 435,000 tons C02 emissions (equivalent to 117,840 homes in South Africa)
- Generated $8mil in additional revenue, cost savings, and private investments

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Some examples

Waste wood -> wooden pallets

- Waste management company, wooden pallet company
- Diverted 79 tons of wood waste from landfill, saves the companies money, and keeps virgin wood from being used

Waste egg whites -> confections (sweets)

- Ice cream manufacturer, confectionary company
- Saved on waste disposal costs for the first and made add'l revenue for the second

Organic waste -> insect feed

- Waste management company, insect farming company
- 3,360 tons of organic waste is being sold to feed insects instead of going to a landfill

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Which of the following urban policies align with circular economy goals...while also minimizing unintended environmental harm?

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Why?

B. Local material reuse hubs support the circular economy by facilitating the reuse of construction materials, reducing the demand for virgin resources.

D. Take-back programs for electronics encourage recycling and proper disposal, aligning with circular economy principles.

A. While promoting electric vehicles can reduce emissions, it doesn't directly address material reuse or waste reduction.

C. Waste-to-energy incineration can reduce landfill use but may discourage recycling and doesn't promote material reuse.

TechUK

According to recent data, which sector is most frequently underestimated in urban sustainability plans despite having a high impact on emissions and resource consumption?

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Why?

The construction sector, including building operations, significantly contributes to urban emissions and resource consumption. However, its impact is often underestimated in sustainability planning.

ScienceDirect

A city introduces green roofs across all municipal buildings. Which of the following should be considered to assess whether this contributes meaningfully to long-term environmental sustainability?

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Why?

Evaluating the sustainability of green roofs involves considering maintenance capabilities, the environmental impact of construction materials, and ecological benefits like biodiversity enhancement and stormwater management.

US EPA

ScienceDirect

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A city council is debating between two proposals: (1) subsidize compost bins for every household, or (2) invest in a large-scale anaerobic digestion facility. Both address organic waste. What trade-off most accurately describes their difference in long-term sustainability strategy?

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Why?

Household composting encourages individual behavior change and community engagement, while anaerobic digestion offers a scalable solution for organic waste management but may involve less direct public participation.

ScienceDirect

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Which of these challenges often arises when applying circular economy frameworks in cities in the Global South?

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Why?

In many Global South cities, the informal sector plays a crucial role in waste management. However, circular economy initiatives often overlook integrating these informal systems, leading to challenges in implementation.

circle-economy.com

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Green spaces = healthier people

How do they help?

- Cooler temperatures
- More (and hopefully safer) exercise
- Nature decreases stress and depression
- Place for children to play
- Decreased air pollution
  - Fewer cars
  - Plants produce oxygen and filter out air pollutants for better air quality
- Less isolation and more social inclusivity
- Less noise pollution
- Opportunities for urban gardens

**Participatory planning is important!

https://unhabitat.org/sites/default/files/2025/01/final_public_space_and_urban_health.pdf
https://iris.who.int/bitstream/handle/10665/345751/WHO-EURO-2016-3352-43111-60341-eng.pdf

Who benefits more from these?

Photo by Laurentiu Morariu on Unsplash

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the European Union

Studies have shown…

Housewives–and women in general

- Shown to have less stress
- However, may worry more about safety if not designed well–BUT better than exercising on streets, where harassment is more often.
- Pregnant women (reduced blood pressure, reduced depressed, especially for women from disadvantaged groups)

Older people at risk of isolation and less exercise–social ties and community.

Children, who otherwise may not have the option to socialize in a safe space–and with different cultures.

Adolescents

Important to think about the use of space: if all the "play" space is focused on sports that are more traditionally focused on boys (basketball, football), then girls won't feel like it's a space for them.

"Deprived subpopulations and minority groups"

Reduced psychological distress in a deprived urban population in the US
Socioeconomic inequality in mental-wellbeing was 40% narrower among respondents reporting good access to green space
Often have lack of access to cooling systems, so the role of vegetation on cooling urban areas is more important for the urban poor

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the European Union

https://bit.ly/sustainable-cities-folder

Group work:

What is your city doing particularly well around sustainability/circular systems/green space?

What is something they should do better? What would have the most impact, particularly for more vulnerable groups?

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Agenda: Session 5 (Resilience + Final Project)

5 min	Ice breaker
15 min	*Discussion:* What is a resilient city?
5 min	The effects of climate change on cities
10 min	Case studies
15 min	Guest speaker
5 min	STEM careers in sustainable and inclusive cities
20 min	Small group discussions
10 min	Report out
5 min	Post-survey

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Ice breaker

- Name
- School
- Major and year
- What would be your dream job and why?

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What’s a resilient city?

Ability to bounce back from and adapt to various shocks and stresses, such as natural disasters, economic downturns, and social challenges (https://www.e-zigurat.com/en/blog/urban-resilience-sustainable-cities/)

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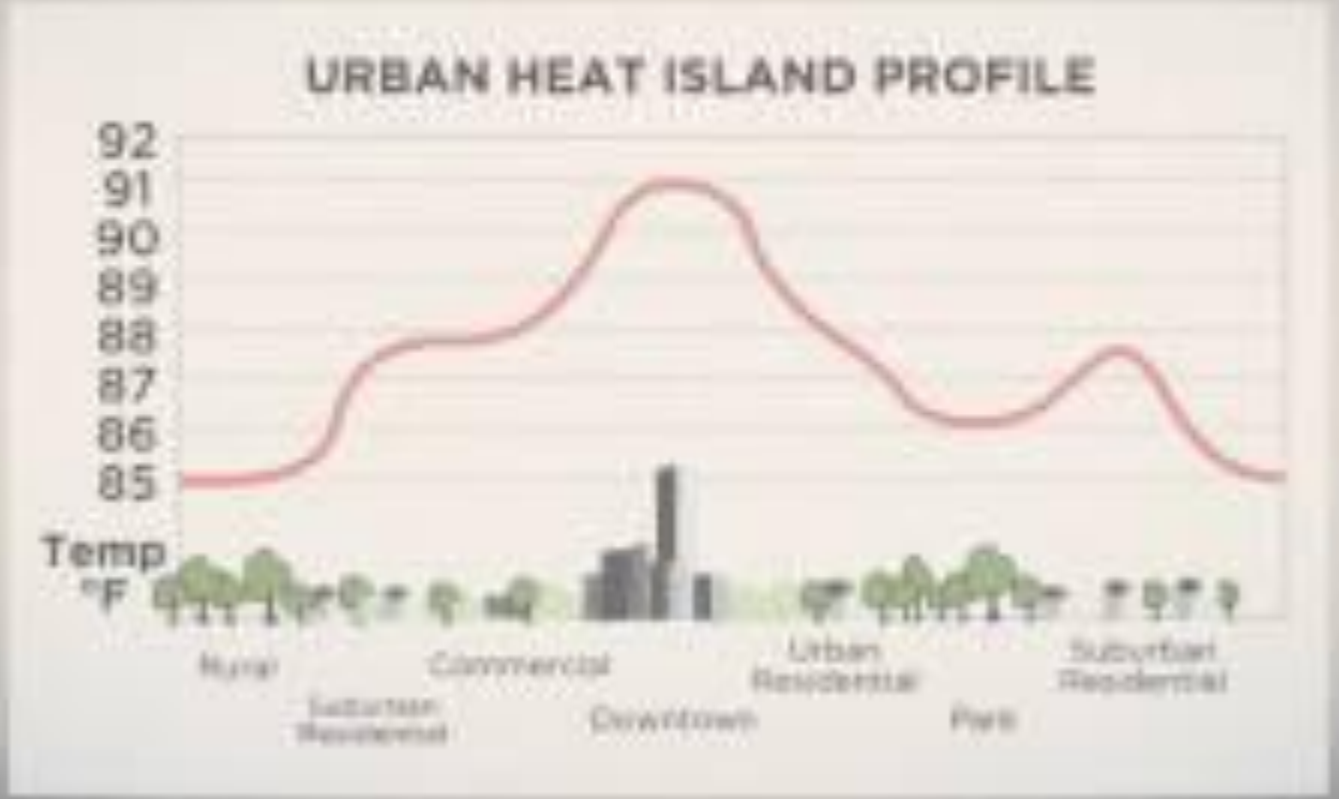
The effects of climate change on cities

Cities: Key impacts



NOAA

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Pathways to resilient cities

1. **Integrate Mitigation and Adaptation:** actions that reduce greenhouse gas emissions while increasing resilience are a win-win.

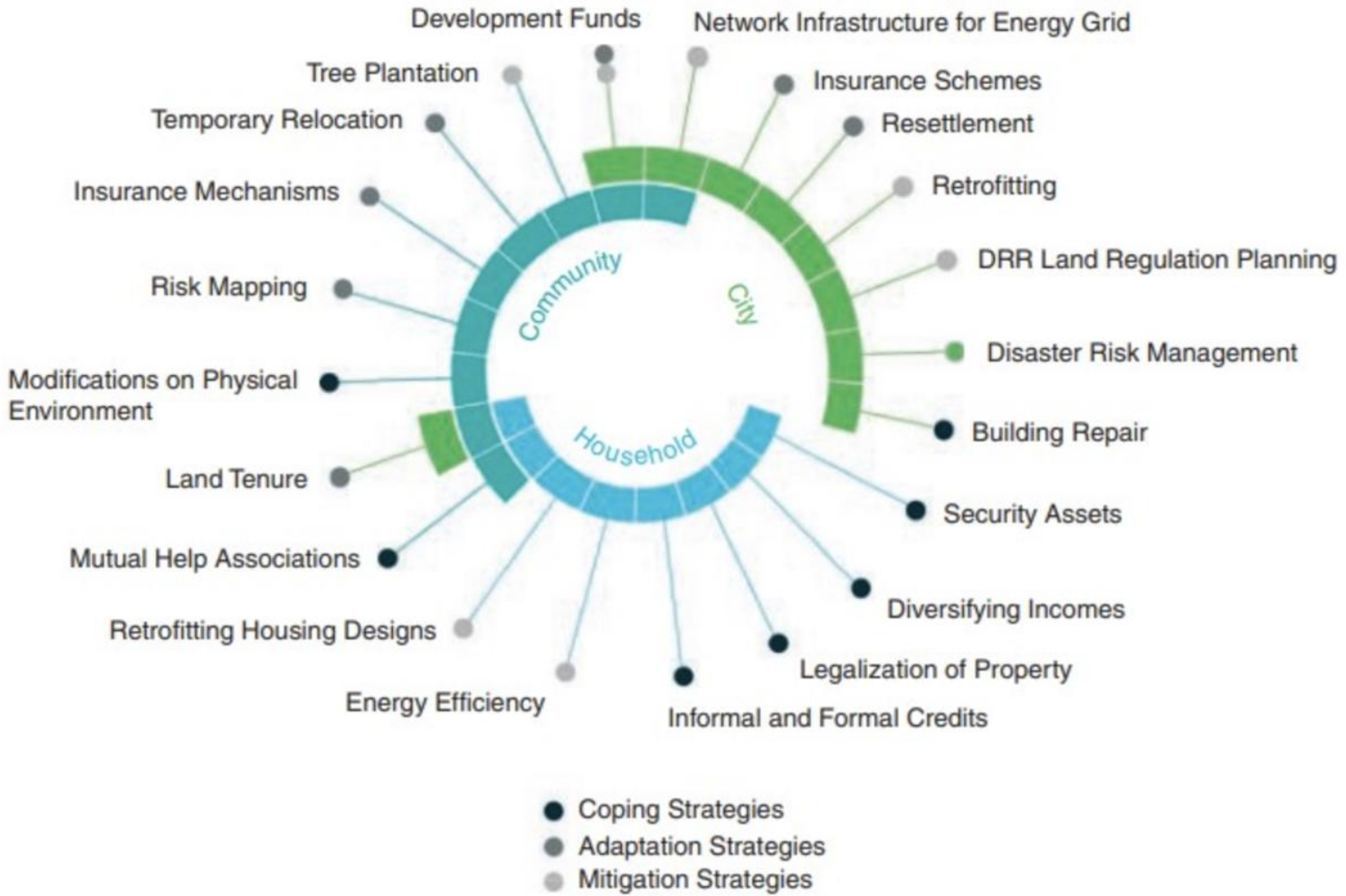
2. **Coordinate Disaster Risk Reduction and Climate Change Adaptation:** Disaster risk reduction and climate change adaptation are the cornerstones of resilient cities.

3. **Co-generate Risk Information:** Risk assessments and climate action plans co-generated with a full range of stakeholders and scientists are most effective.

4. **Focus on Disadvantaged Populations:** Needs of disadvantaged and vulnerable citizens should be addressed in climate change planning and action.

5. **Advance Governance, Finance, and Knowledge Networks:** Developing robust city institutions, advancing city creditworthiness, and participating in city research and action networks enable climate action.

From: https://www.uccrn.education/what-is-the-meaning-of-resilient-city/


Development Funds
Network Infrastructure for Energy Grid
Tree Plantation
Insurance Schemes
Temporary Relocation
Resettlement
Insurance Mechanisms
Retrofitting
DRR Land Regulation Planning
Risk Mapping
Community
City
Disaster Risk Management
Modifications on Physical Environment
Household
Building Repair
Land Tenure
Security Assets
Mutual Help Associations
Diversifying Incomes
Retrofitting Housing Designs
Legalization of Property
Energy Efficiency
Informal and Formal Credits
Coping Strategies
Adaptation Strategies
Mitigation Strategies

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Earthquake readiness in Wellington, New Zealand

Problems addressed:

On top of a fault line (earthquakes, tidal flooding, storm surge)

Effects of those on buildings, electricity, and drinkable water

- Empowered residents through a participatory planning and budgeting process (not just focused on climate resilience!)
- Retrofitted 113 buildings and upgrading another 600
- Surcharge to pay for upgrading their power network to withstand disasters
- Constructed 22 river-fed emergency drinking water locations (if an earthquake ruptures underground pipes–will provide more than 200,000 people with a secure water supply and ensure that residents will not have to walk more than 1 kilometer to get access to drinking water.

https://resilientcitiesnetwork.org/downloadable_resources/UR/100-Resilient-Cities-Midterm-Evaluation-Report-Case-Studies.pdf

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Green bus stops in Poland

Problems addressed:

Urban heat island effect

Excess of rainwater runoff

Livability (green space!)

https://stateofgreen.com/en/news/12-examples-of-climate-resilient-city-solutions/

Co-funded by
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Other case studies

Bangkok, Thailand

Key resilience themes

- Flood management
- Informal settlements
- Green infrastructure

Resilience strategies

- Bangkok Resilience Strategy focuses on aging infrastructure, floods, and social fragmentation
- Urban Flood Resilience Project combines green infrastructure and drainage upgrades
- Community Resilience Networks enable grassroots capacity-building and early warning systems

Impact: Blends infrastructure with social systems to address chronic shocks and stresses

Medellín, Colombia

Key resilience themes

- Social inclusion
- Mobility
- Climate adaptation

Resilience strategies

- Metrocable public transit system connects marginalized hillside neighborhoods to the city center
- Green Corridors program adds green space and reduces the urban heat island effect
- Participatory urban planning involves residents in decisions on land use and infrastructure

Impact: Transformed from a violent city into a model of urban innovation and resilience

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Grant agreement: 2022-1-SE01-KA220-HED-000086239

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Sustainable and Inclusive Cities

June 2025

Instructor: Janice Levenhagen, Katja Legisa

Women STEM UP Project Number: **2022-1-SE01-KA220-HED-000086239**

LINKÖPING UNIVERSITY

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STIMMULI for social change

NTNU Norwegian University of Science and Technology

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Who am I?

- Computer engineer turned gender equity in STEM and entrepreneurship
- Left tech due to harassment and bias–very passionate about changing that for other women
- Launched and ran a nonprofit for girls and women in tech in the US for 8 years. 20+ cities, serving 8,000 people per year with 1,500 volunteers
- Now I do consulting for organizations serving women and girls, work on EU projects like this, and run a nonprofit called Wevise (wevise.org) around mentorship in tech

Photo by Todd Kulesza, ChickTech, Flickr, used with permission

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Women STEM Up Project

✔ EU-funded project to support young women in STEM majors to improve their confidence, passion, and creativity, with the end goal of encouraging them to stay in STEM.

✔ Also, to help universities do a better job of supporting women in STEM majors

✔ This course is part of ‘Women STEM Up for Good’, which focuses on boosting women’s (your) passion for STEM using ESTEAM for social good

✔ By attending all 5 sessions, you will receive a certificate of participation, which you can add to your CV and LinkedIn

✔ If you’re in one of the project countries (Belgium, Sweden, Norway, or

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Sessions

1: Introduction to Sustainable and Inclusive Cities

2: Inclusive Urban Design

3: Smart Cities

4: Environmental Sustainability and the Circular Economy in Urban Design

5: Resilient Cities

****Focus is on exploration, discussion, critical thinking, and problem solving. Participation is critical!****

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Agenda: Session 1 (Introduction)

10 min	Introduce instructor and course
5 min	Student intros and ice breaker
10 min	*Discussion:* What issues do cities currently have?
5 min	*Quiz:* Why is this important?
7 min	*Discussion+video:* What is a sustainable city?
7 min	*Discussion:* What is an inclusive city?
5 min	*Definition:* Smart and cognitive cities
8 min	*Overview:* SDG 11
10 min	*Video:* 7 principles for building better cities
5 min	BREAK

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Ice breaker

- Name
- School
- Major and year
- If you could solve one problem in the world today, what would it be and why?

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What issues do cities struggle with?

Newsletters

Context

Know better. Do better.

Journalism from the Thomson Reuters Foundation

World's slum populations set to surge as housing crisis bites

Nita Bhalla
Updated: June 08, 2023

Share

Women wash laundry at a water puddle within the Kibera slums in Nairobi, Kenya, July 21, 2020. REUTERS/Monicah Mwangi

https://www.context.news/socioeconomic-inclusion/worlds-slum-populations-set-to-surge-as-housing-crisis-bites | Screenshot taken May 11, 2025

Informal settlements

d by
bean Union

Air pollution

https://time.com/9802/beijing-air-pollution-nuclear-winter/ | Screenshot taken May 11, 2025

TIME

SUBSCRIBE

WORLD • AIR POLLUTION

China's Smog Is So Bad They're Now Calling It a 'Nuclear Winter'

3 MINUTE READ

Good morning, Beijing: The view from Beech's 16th-floor apartment on Feb. 26 in Beijing's Central Business District. The building in the background is the tallest in the city Hannah Beech

BY HANNAH BEECH

FEBRUARY 26, 2014 1:10 AM EST

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Home › Mumbai › Mumbai: Traffic congestion on Western and Eastern Express Highway amid backlogs and breakdown of buses

Mumbai: Traffic congestion on Western and East Highway amid backlogs and breakdown of buse

Vehicular movement was reported to be slow on Eastern Express Highway and to backlog upto BKC, BEST Bus breakdown reported near Aarey in Goregaon ar

Aishwarya Iyer | **Updated:** Monday, September 19, 2022, 07:59 PM IST

Traffic Jam in Mumbai | Photo: PTI

https://www.freepressjournal.in/mumbai/mumbai-traffic-jams-hit-city-roads | Screenshot taken May 11, 2025

Traffic congestion

The Dublin Shield
THE VOICE OF DUBLIN YOUTH

Keep it Inclusive – The Lack of Accessibility within Community Spaces

Kori Velasco, Staff Writer | January 25, 2023

Over the past few decades, monumental technological advances have been made in the field of medicine and disabilities. However, despite this progress,

https://thedublinshield.com/uncategorized/2023/01/25/keep-it-inclusive-the-lack-of-accessibility-within-community-spaces/

Inaccessible public spaces

by
an Union

Poor waste management

https://climate.gov.ph/news/923 | Screenshot taken May 11, 2025

Office of the President of the Philippines
CLIMATE CHANGE COMMISSION

Ridge to Reef: The Fight Against Mismanaged Waste

September 09, 2024 Monday

Photo by: Albert Alcain

yahoo!news

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News Latest National World Environment Sport

Kamilia Palu · News Editor
Updated Fri 9 May 2025 at 5:35 am GMT+2 · 6-min read

Monash experts Professor Louise Wright and Associate Professor Catherine Murphy (pictured) say Melbourne's urban sprawl has come at a great cost to habitat and biodiversity. Photo: Nigel Bertram

https://au.news.yahoo.com/photos-show-huge-problem-facing-australias-fastest-growing-city-such-a-high-price-033547779.html

Urban sprawl

GREENPEACE

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Inequality and transport: who decides where you go?

Nerea Ramírez Piris
20 September 2023 • 3 min read

Transport systems are typically designed for men, and service the journeys they want to make. This is especially true for middle-aged, white, cis-male, able bodied, wealthy men. If you don't fit this description, transport might not serve your daily needs.

Copenhagen, Denmark. In some cities, cycle paths are also accessible for people using wheelchairs or mobility scooters to get around, enabling people living with and without disabilities to join in social rides. © Chris Grodotzki / Greenpeace

https://www.greenpeace.org/international/story/62407/inequality-and-transport-who-decides-where-you-go/

Inequitable transport systems

d by
ean Union

Heat islands/lack of green space

https://www.scidev.net/global/news/urban-heat-islands-increasing-faster-in-poorer-cities/ | Screenshot taken May 11, 2025

SciDev Net — Bringing science & development together through news & analysis — Menu

Home / News

17/04/25

Urban heat islands 'increasing faster' in poorer cities

A section of Cairo city at sunset. A new study published in the journal Urban Sustainability indicates that urban areas are heating up at an average rate of 0.021 degrees Celsius per year. Copyright: Matt Wan (CC BY-NC-ND 2.0)

South China Morning Post

Indonesia | This Week in Asia / Health & Environment

Jakarta's floods worsen, displacing thousands as extreme weather, poor planning collide

Extreme weather and poor urban planning have exacerbated Jakarta's annual flooding, displacing residents and highlighting critical infrastructure failures

Reading Time: **3 minutes**

Resty Woro Yuniar

Published: 8:27pm, 11 Mar 2025 | Updated: 9:12pm, 11 Mar 2025

https://www.scmp.com/week-asia/health-environment/article/3301976/jakartas-annual-floods-worsen-displacing-thousands-extreme-weather-poor-planning-collide

Flooding due to inadequate infrastructure

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the European Union

Why is this important?

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What percentage of Earth's land do cities occupy?

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What percentage of the world's population lives in cities?

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the European Union

How much energy do cities consume?

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By 2050, how many people are expected to live in slums?

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What is a sustainable city?

WOMEN STEM UP


ENVIRONMENT
SOCIAL
ECONOMY
ECOLOGICAL
HUMAN NEEDS
DURABILITÉ
TRIPLE BOTTOM LINE

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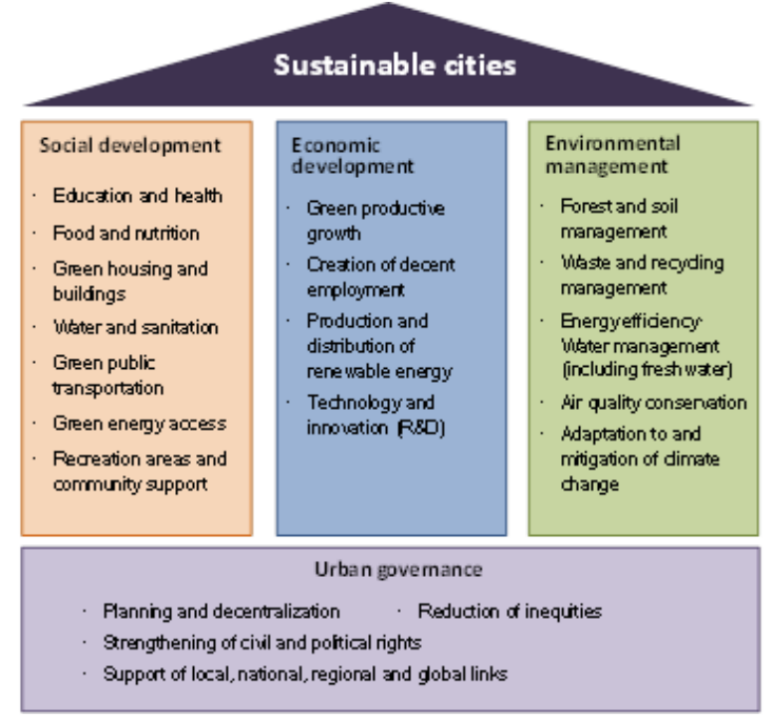

https://sustainabledevelopment.un.org/content/documents/2948chairsummaryside2.pdf

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What is an inclusive city?

- What could cause different experiences between different people?
- What ARE “different” people? Different from who?
- What might those different experiences look like?

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Two more definitions

- **Smart city:**
  Uses data and digital technologies (IoT, sensors, AI) to improve urban services like traffic, energy, and public safety. Focus is on efficiency, connectivity, and innovation.

- **Cognitive city:**
  Goes further by incorporating machine learning and adaptive systems that learn from residents' behaviors and predict needs. Emphasis is on anticipating change and human-centric adaptation.

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SDG 11:

Make cities and human settlements inclusive, safe, resilient and sustainable

By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums

By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons

By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries

Strengthen efforts to protect and safeguard the world's cultural and natural heritage

TARGET 11·5

REDUCE THE ADVERSE EFFECTS OF NATURAL DISASTERS

By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations

TARGET 11·6

REDUCE THE ENVIRONMENTAL IMPACT OF CITIES

By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management

TARGET 11·7

PROVIDE ACCESS TO SAFE AND INCLUSIVE GREEN AND PUBLIC SPACES

By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries

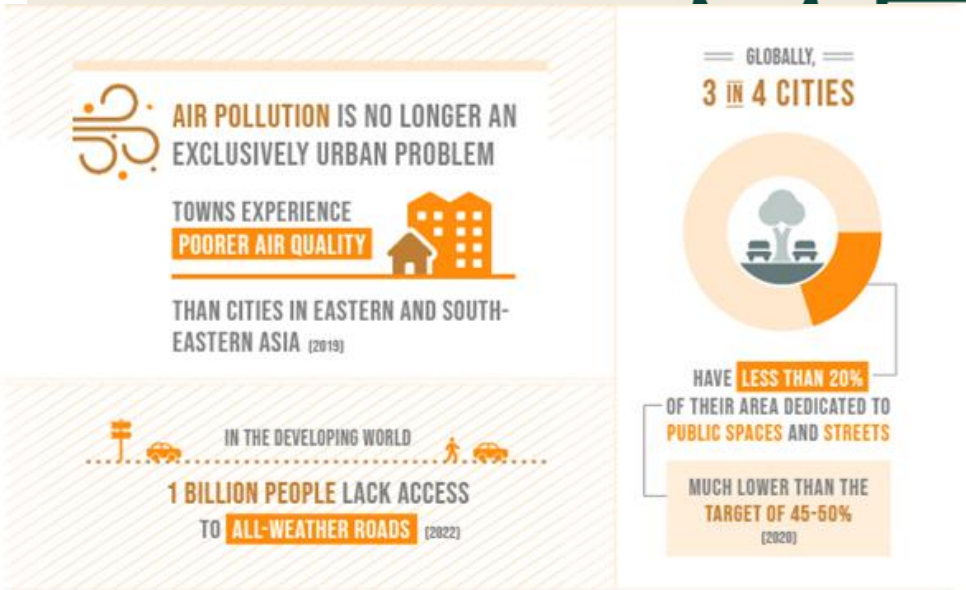
TARGET 11·A

STRONG NATIONAL AND REGIONAL DEVELOPMENT PLANNING

Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning

By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels

Support least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials



https://unstats.un.org/sdgs/report/2023/

THE SUSTAINABLE DEVELOPMENT GOALS REPORT 2023: SPECIAL EDITION- UNSTATS.UN.ORG/SDGS/REPORT/2023/

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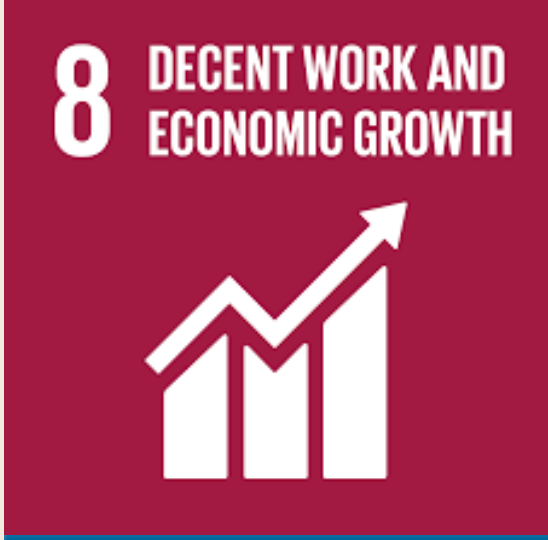
ALSO

- SDG 8: Promote sustained, inclusive, and sustainable economic growth
- SGD 16: Promote peaceful and inclusive societies for sustainable development



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BREAK

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Grant agreement: 2022-1-SE01-KA220-HED-000086239

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Sustainable and Inclusive Cities: Inclusive Urban Design

June 2025

Instructor: Janice Levenhagen, Katja Legisa

Women STEM UP Project Number: **2022-1-SE01-KA220-HED-000086239**

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STIMMULI for social change

NTNU Norwegian University of Science and Technology

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Sessions

1: Introduction to Sustainable and Inclusive Cities

2: Inclusive Urban Design

3: Smart Cities

4: Environmental Sustainability and the Circular Economy in Urban Design

5: Resilient Cities and Final Project

****Focus is on exploration, discussion, critical thinking, and problem solving. Participation is critical!****

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Agenda: Session 2 (Inclusive Urban Design)

5 min	Review of ideas from first session
15 min	Overview of inclusivity issues
10 min	*Discussion+case study:* Why is this important?
5 min	UN Women
10 min	Examples
15 min	Small group discussions
10 min	Report out

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Do not edit
How to change the design

What is the goal of inclusive cities, and why is this important?

Equiterra, a country of equality, as imagined by UN Women

Credit: UN Women/Ruby Taylor
https://un-women.medium.com/welcome-to-equiterra-where-gender-equality-is-real-6fc832c383fe

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Who are affected differently by cities?

Sexual Orientation/ Gender Identity

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Some facts (the bad)

- Less than 10% of the Paris metro network is wheelchair accessible
- In Dhaka, Bangladesh, a city of over 23 million, less than 2% of roads have proper pedestrian infrastructure, disproportionately affecting children, the elderly, and people with disabilities.
- In LA, wealthier neighborhoods have up to 42% tree canopy coverage, compared to just 10–15% in low-income areas, worsening urban heat for already vulnerable populations.
- According to UN Women, 99.3% of women in Cairo report experiencing sexual harassment in public spaces, a major barrier to gender-inclusive mobility and participation in city life.
- About 70% of Lagos's 20+ million residents live in informal settlements or slums with limited access to water, sanitation, and transport, despite the city's massive economic growth.
- In São Paulo, low-income residents from peripheral areas often spend over 4 hours a day commuting, largely due to poor transit access and urban sprawl — reducing time for education, caregiving, and community life.

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Some facts (the good)

- Paris plans to expand its bike lane network to over 1,000 km by 2026, prioritizing mobility for non-drivers and reducing transport inequality, particularly for women and young people.
- Over 3,000 cities globally (including New York, Paris, and Porto Alegre) now use participatory budgeting, allowing residents—especially marginalized groups—to directly influence how public funds are spent. In Surabaya, Indonesia, 50% of its annual municipal budget is allocated to local community projects
- Around 60% of Vienna's population lives in city-owned or subsidized housing, helping prevent gentrification and keeping neighborhoods mixed and accessible across income levels.
- The Metrocable system in Medellín reduced commute times for hillside residents by 40%, providing affordable access to jobs, education, and healthcare for low-income communities.
- In Barcelona, car traffic dropped by 25% in areas where superblocks were implemented, giving more space to pedestrians, kids, and disabled residents while reducing air and noise pollution.
- Kigali (Rwanda) implemented a citywide safety code for public transport, including complaint hotlines and driver accountability, contributing to a reported 35% drop in harassment cases on buses within the first year.
- To combat heat and flooding, Freetown launched a "Freetown the Treetown" initiative, planting 500,000 trees by 2023 with resident involvement, improving resilience and equity in informal settlements hit hardest by climate change.

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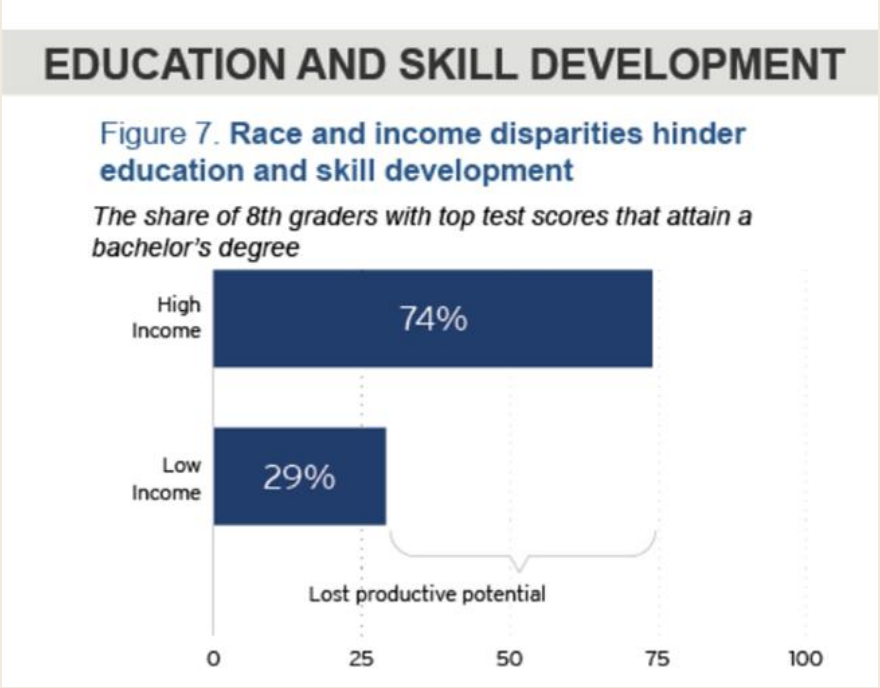
Case study: the cost of unequal economic opportunity



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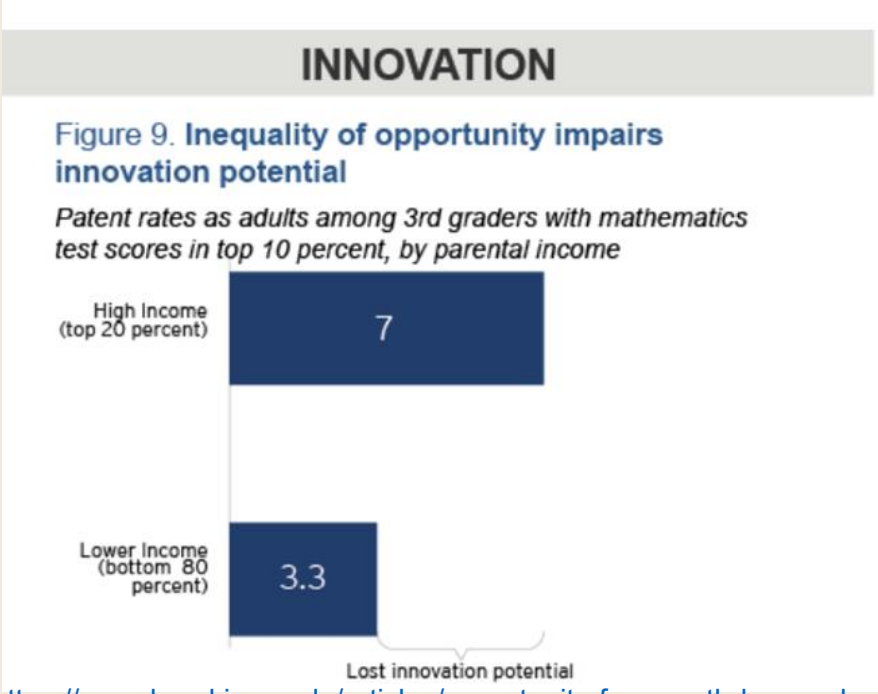
Case study: the cost of unequal economic opportunity



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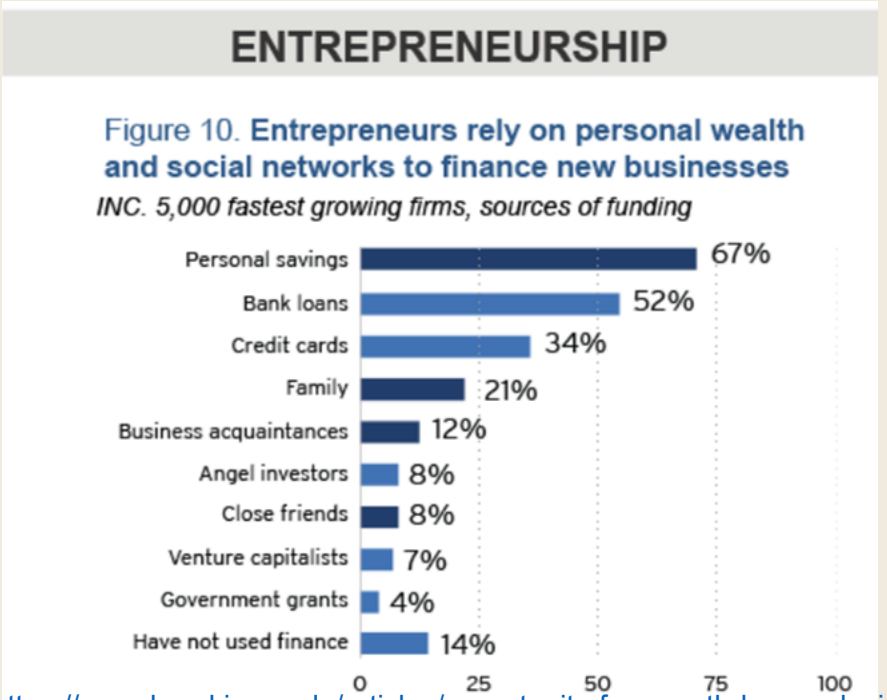
Case study: the cost of unequal economic opportunity



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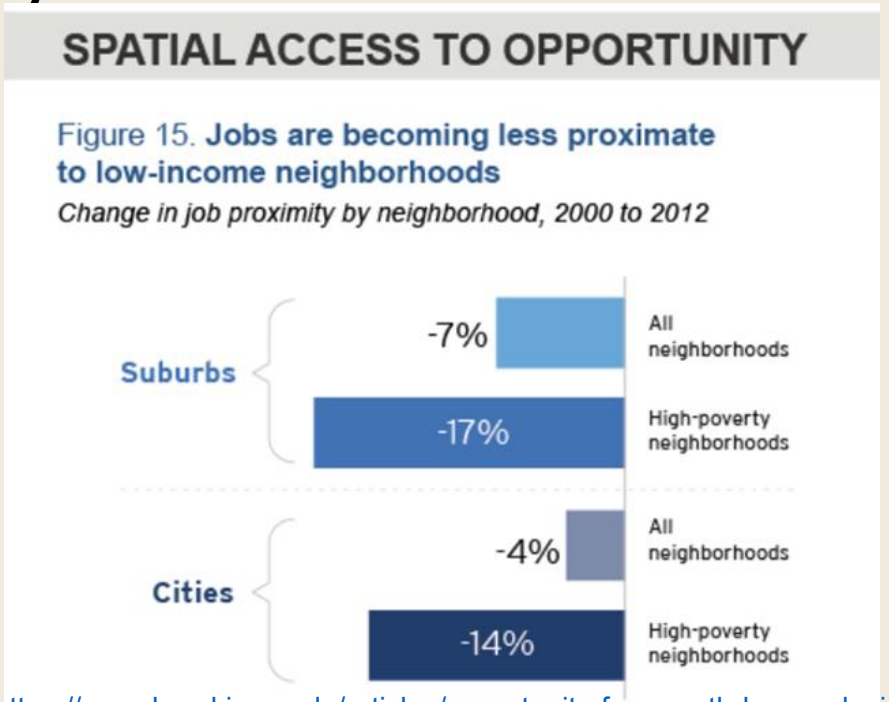
Case study: the cost of unequal economic opportunity



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Case study: the cost of unequal economic opportunity (cont'd)

- Childhood poverty (an outcome of insufficiently inclusive growth) costs the US economy ~$500bil per year–4% of GDP, due to lost productivity, higher crime and incarceration, and larger health expenditures
- Hostilities that fray social and political cohesion and good governance (which affects economic growth)

 https://www.brookings.edu/articles/opportunity-for-growth-how-reducing-barriers-to-economic-inclusion-can-benefit-workers-firms-and-local-economies/

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UN Women

Safe Cities and Safe Public Spaces

Global flagship initiative to prevent sexual harassment in public spaces. Partner cities include Cairo, Quito, Port Moresby, Delhi, and Kigali.

Focus on:

- Ending violence against women
- Economic empowerment
- Leadership and governance
- Gender mainstreaming and institutional development

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Example: Women's safety audits

- Women and community members walk through neighborhoods to identify unsafe areas (poor lighting, lack of transport, overgrown areas, etc.)
- Originated in Toronto in the 1980's (METRAC–group of women who came together to fight against sexual assault and murder of women)
- Start close to dusk to see area during day and night
- Shows how participation of the groups affected is critical

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Case Study: Women's safety audits

Delhi, 2013

- 95% of women and girls in Delhi said they felt unsafe in public spaces
- 51% of men reported that they had themselves perpetrated sexual harassment or violence against women and girls in public spaces in Delhi. In the study, 25 per cent said they had done so in the last six months.
- In cases of sexual violence, many men blamed women for their behaviour. In the study, three out of four agreed with the statement 'Women provoke men by the way they dress' and two men out of five fully or partially agreed that 'Women moving around at night deserve to be sexually harassed'.
- Nearly 73 per cent of women said they do not feel safe in their own surroundings as well, and reported feeling unsafe all the time.

https://www.unwomen.org/en/news/stories/2013/2/un-women-supported-survey-in-delhi

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Case Study: Women's safety audits

Findings

- Insensitive attitudes of the police and public transport staff including drivers and conductors
- Gaps in provision and effectiveness of essential services (access to telephone booths, police and 24-hour hospitals)
- Poor lighting near bus stops (and in general a need for more street lighting infrastructure)
- Lack of well-maintained public toilets
- Absence of pavement
- "Never before was violence against women considered an urban planning problem. But now more urban planners and policymakers are reviewing urban design – thanks to our programme," says Sushma Kapoor, Officer-in-Charge, UN Women.
- "The programme has really helped to make women an equal partner in ensuring their safety. Women are now able to speak of their experiences directly to the police, and tell us what is needed to be done," says Suman Nalwa, Additional District Commissioner of Police, Special Police Unit for Women and Children.
- source

Technology: Safetipin

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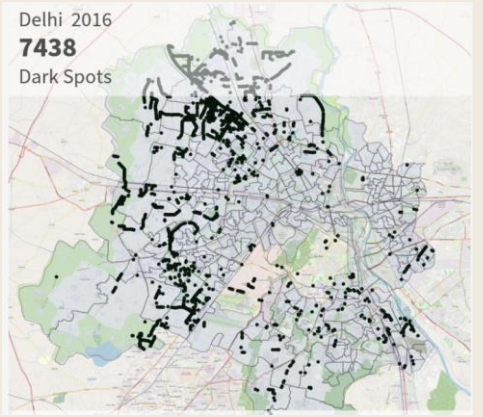
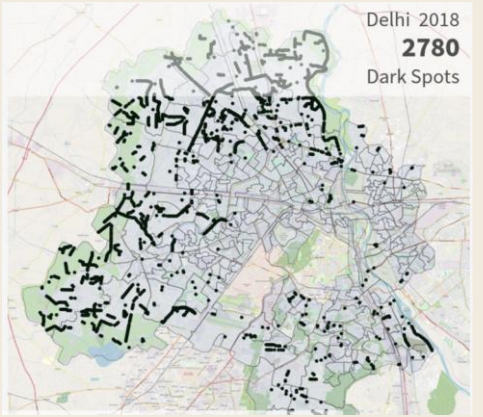
SAFETIPIN
Supporting Safer Cities





Technology: Safetipin

- NGO created an app for crowdsourcing information on unsafe areas in towns, sharing that data with the public and governments so they can be addressed
- Launched in Delhi in 2013 but now in 16 countries and 78 cities, almost 600,000 audits
- Data used as inputs to where lighting could be improved, and the Delhi Police used it to reformulate their patrolling routes
- Digital Divide (poverty, gender)--
  - Worked with NGOs to hear the voices of marginalized people
  - Supported women working in groups so those without smartphones could participate (with others who did have them)
  - Provided posters with the information in different areas so residents could see and provide thoughts/feedback in person.

Study

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Choose a city from the list for small-group breakouts

You'll be working in these groups for the rest of the sessions!

- Singapore
- Copenhagen
- New York City
- Amman
- Nairobi
- Bogotá

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Steps

- Step 1: Inclusivity issues and potential fixes
- Step 2: Using technology focused on urban design to address one of the issues
- Step 3: Examining the environmental sustainability of the various options to solve the issues, with a final proposal with pros and cons

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What are the three biggest inclusivity issues in the city you chose?

Choose one and discuss how that could be fixed (focus on urban design).

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Report out

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Next week:

- Smart cities
- Sustainability and the circular economy

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Thank you and see you soon!

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Sustainable and Inclusive Cities: Smart Cities

June 2025
Instructor: Janice Levenhagen

Women STEM UP Project Number: **2022-1-SE01-KA220-HED-000086239**

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Sessions

1: Introduction to Sustainable and Inclusive Cities

2: Inclusive Urban Design

3: Smart Cities

4: Environmental Sustainability and the Circular Economy in Urban Design

5: Resilient Cities

****Focus is on exploration, discussion, critical thinking, and problem solving. Participation is critical!****

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Agenda: Session 3 (Smart cities)

5 min	Ice breaker
5 min	*Refresher:* What's a smart city?
5 min	*Video:* Overview of smart cities
5 min	*Discussion:* What examples have you seen in your daily lives?
10 min	*Overview:* The tech
10 min	*Discussion:* What issues are there?
5 min	Inclusivity issues
5 min	Different parts of the city that use tech
15 min	Small group discussions
10 min	Report out
5 min	BREAK

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Ice breaker

- Name
- School
- Major and year
- What’s your favorite tech product and why?

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Review: What's a smart city?


DW
Smart
Cities
SHIFT

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What examples have you seen in your daily lives or travels?

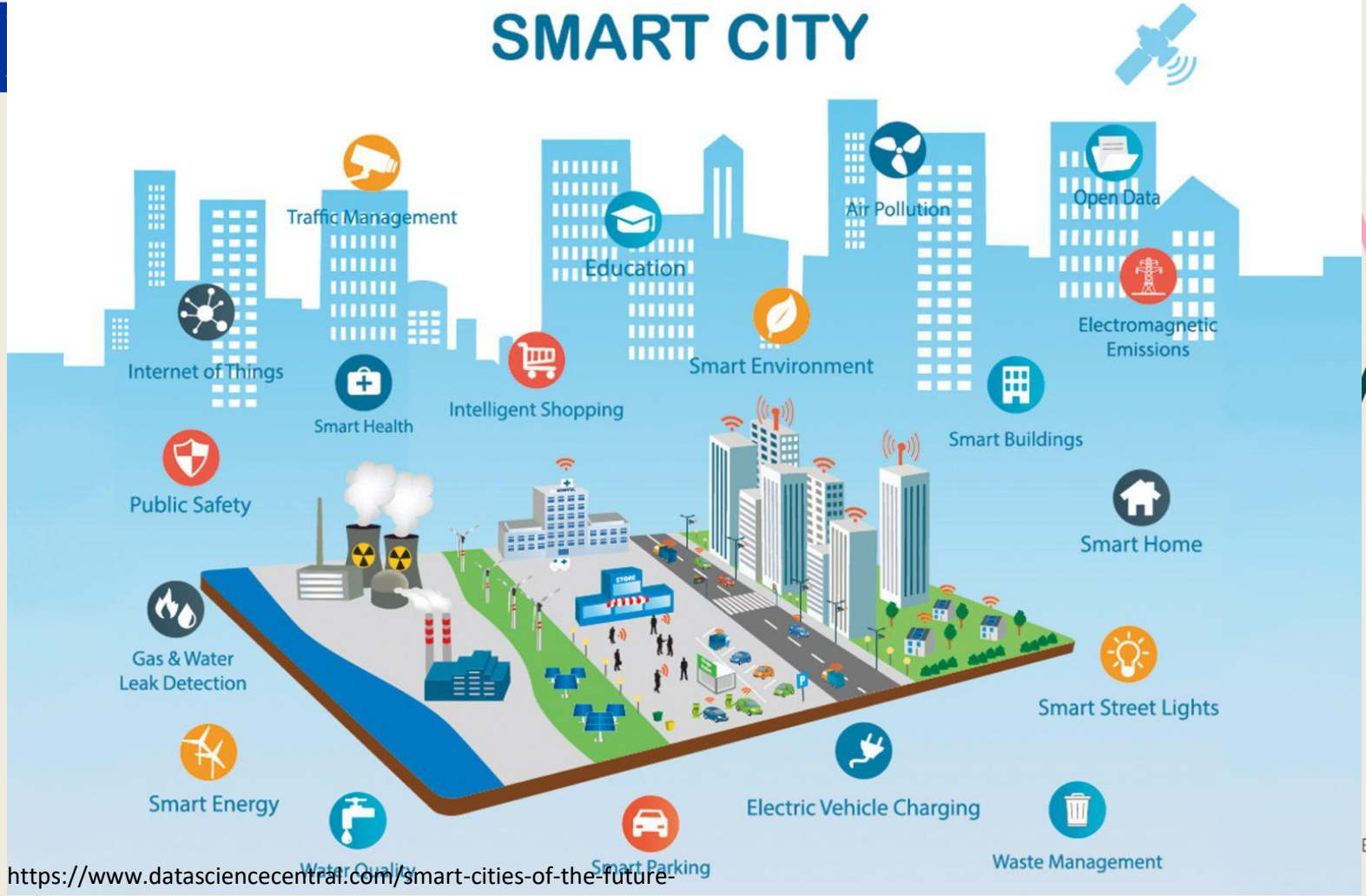

Photo credit: https://www.datasciencecentral.com/smart-cities-of-the-future-powered-by-iot/

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The tech

IoT 	network of devices that connect to each other and the cloud
5g 	the network that allows a lot more people/devices to send much more data with much higher speed and lower latency (allowing for near real-time)
Big data 	all of the data created by sensors, people, weather satellites, etc. Includes structured, semi-structured, not structured
Blockchain 	secure, private, and transparent way to transmit data
AI 	the ability to “think” about all of this information in a way that allows for predictive analysis
Edge computing 	the computing is done in the local area/device so that the data doesn’t need to be sent to a central “cloud” for processing

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Example: Traffic Optimization System

To reduce congestion, cut emissions, and improve emergency response times

IoT (Internet of Things)
→ Smart traffic lights, cameras, pollution monitors, and connected vehicles continuously gather real-time data (vehicle counts, speed, weather, air quality, road conditions).

5G
→ Enables real-time data exchange between IoT devices, vehicles, and traffic control centers. Emergency vehicles can instantly communicate with traffic lights to prioritize green signals.

Big Data
→ The system collects and processes data from thousands of sensors and external sources (e.g. weather forecasts, public transport GPS feeds) to understand patterns and predict traffic flows.

AI (Artificial Intelligence)
→ AI models analyze incoming data to adjust traffic lights dynamically, reroute traffic during accidents or construction, and predict congestion before it happens.

Blockchain
→ All data interactions (like vehicle location updates, traffic light changes, or ride-sharing transactions) are stored securely and transparently. Blockchain also helps in managing microtransactions—for example, rewarding citizens with crypto-tokens for using less congested routes or public transport.

Edge Computing
→ Reduces latency and bandwidth usage by processing critical data (like traffic camera feeds) locally rather than sending everything to a central cloud.

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What issues are there with this kind of technology?

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People/Inclusivity

- Technocentrism over human-centered design
- Digital divide
- Surveillance and privacy (& social engineering)
- Algorithmic bias
- Public participation gaps
- Gentrification and displacement
- Labor and human rights issues in tech supply chains

Environment

- Greenhouse gas emissions
- E-waste and resource extraction
- Energy consumption of smart infrastructure
- Greenwashing and token sustainability
- Climate resilience gaps
- Water use and pollution from tech infrastructure
- Greenhouse gas emissions from tech operations and supply chains

Technology

- Bugs and inaccuracy of algorithms
- Data accuracy (and “overfitting”)
- Security vulnerabilities
- Interoperability challenges
- Over-reliance on technology
- Cost and vendor lock-in

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Case studies

Potholes and smartphones (Boston)

- Smartphone app to discover potholes on public roads through automated recognition by the phone's accelerometer
- However, lower income (and particularly older) residents, had fewer smartphones (16%)
- Therefore, lower income areas that may have more potholes would get fewer resources to fix them.

https://www.sciencedirect.com/science/article/pii/S2515856220300067

Predictive policing (UK)

- Smart Information System (SIS): AI+Big Data
- 2023: 24.5 stops and searches for every 1,000 Black people, 5.9 for every 1,000 white people
- This biased data is then fed into the algorithms, which is in turn fed back to police

https://www.researchgate.net/publication/304746305_Privacy_concerns_in_smart_cities
https://www.amnesty.org.uk/press-releases/uk-police-forces-supercharging-racism-crime-predicting-tech-new-report

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“Racism has always been about predicting, about making certain racial groups seem as if they are predisposed to do bad things and therefore justify controlling them.”

Dorothy Roberts, writer and academic, University of Pennsylvania

Video: “Policing without the police: race, technology and the new Jim Code”

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AGAIN: must be people-centric and participatory!

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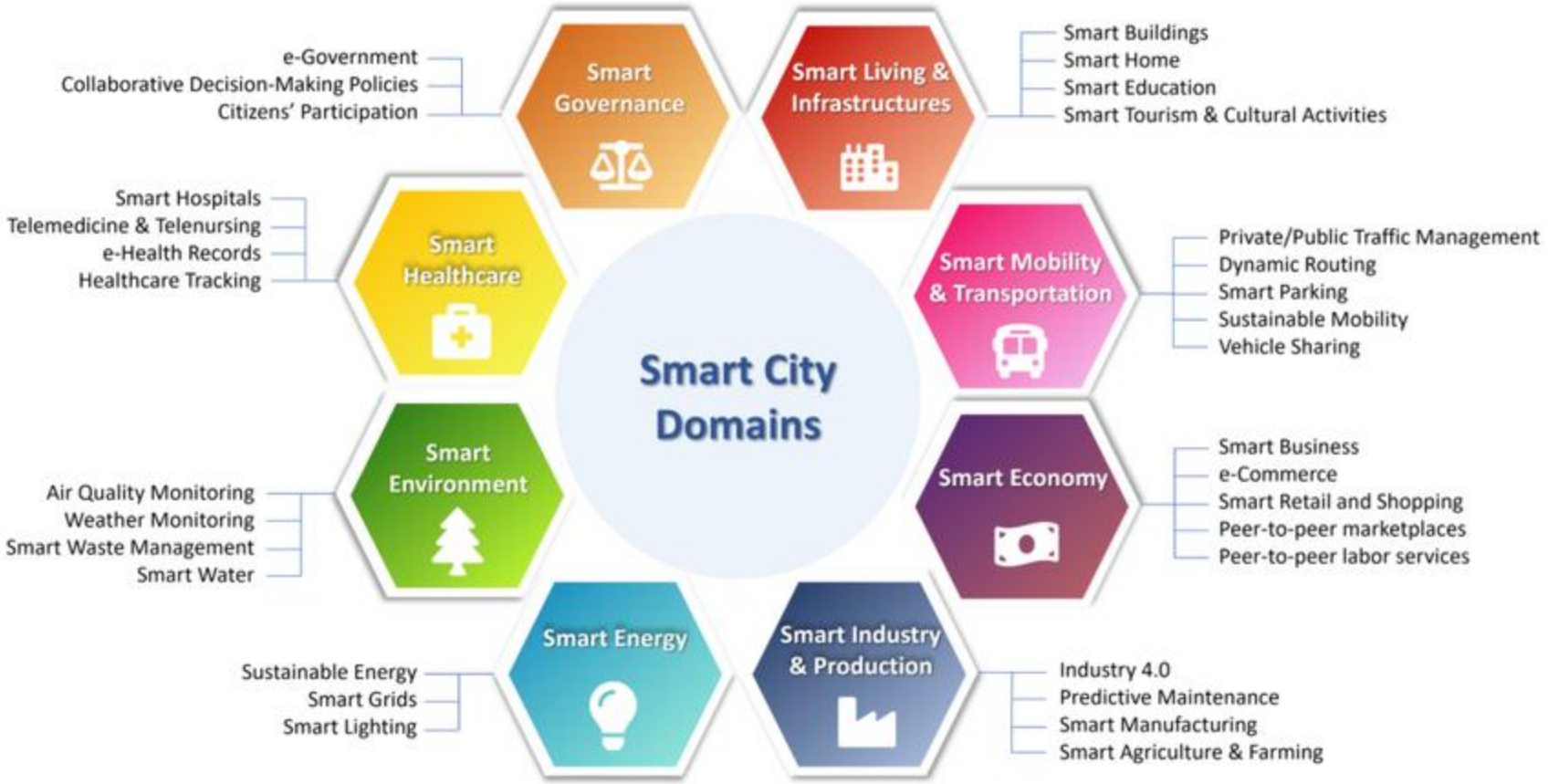

Image from: Bellini, Pierfrancesco & Nesi, Paolo & Pantaleo, Gianni. (2022). IoT-Enabled Smart Cities: A Review of Concepts, Frameworks and Key Technologies. Applied Sciences. 12. 1607. 10.3390/app12031607.

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Group work:

How could you use technology to (partially) fix the inclusivity issue(s) you chose? Be specific!

What are the drawbacks? Is anyone left out?

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Report out

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BREAK

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Sustainable and Inclusive Cities:
Environmental Sustainability and the Circular Economy in Urban Design

June 2025

Instructor: Janice Levenhagen

Women STEM UP Project Number: **2022-1-SE01-KA220-HED-000086239**

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Agenda: Session 4 (Environmental sustainability and circular economy)

15 min	Introduction
5 min	*Video:* What is a circular economy/circular city?
10 min	Circular city case studies
10 min	*Quiz:* Critical thinking around environmental sustainability
10 min	Green cities + green spaces = healthier people
15 min	Small group discussions
5 min	Report out

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Review:What’s a green city?

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An environmentally sustainable city (eco-city/green city), is an urban area designed and managed to meet the needs of its present inhabitants **without compromising the ability of future generations to meet their own needs** — with a specific emphasis on minimizing its environmental footprint.

Environmental sustainability in cities means ensuring that urban development:

- Reduces emissions and pollution (air, water, noise, and soil),
- Protects and regenerates ecosystems and biodiversity,
- Manages natural resources responsibly, especially energy, water, and land,
- Adapts to climate risks like floods, heatwaves, and droughts.

Cities are both the problem and the solution…most of the issues come from cities, but they are also where most of the innovation is coming from as well!


CREATING
SUSTAINABLE
CITIES

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Core environmental priorities for cities

- **Urban Decarbonization**: Transitioning to renewable energy, improving building efficiency, and reducing transport-related emissions.
- **Circular Urban Systems**: Designing out waste, reusing materials, and recovering resources (especially in construction and food).
- **Green Infrastructure**: Integrating natural systems into city planning (green roofs, urban forests, rain gardens).
- **Low-impact Urban Design**: Compact, mixed-use planning that reduces car dependency and preserves surrounding natural areas.
- **Climate Adaptation and Resilience**: Building infrastructure and governance systems that can anticipate and respond to climate shocks.

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Key challenges

- **Urban sprawl** and land-use pressure on ecosystems
- **Overburdened infrastructure** that increases emissions and waste
- **Inequitable environmental burdens** (e.g. pollution in marginalized neighborhoods)
- **Short-term political cycles** vs long-term sustainability investments

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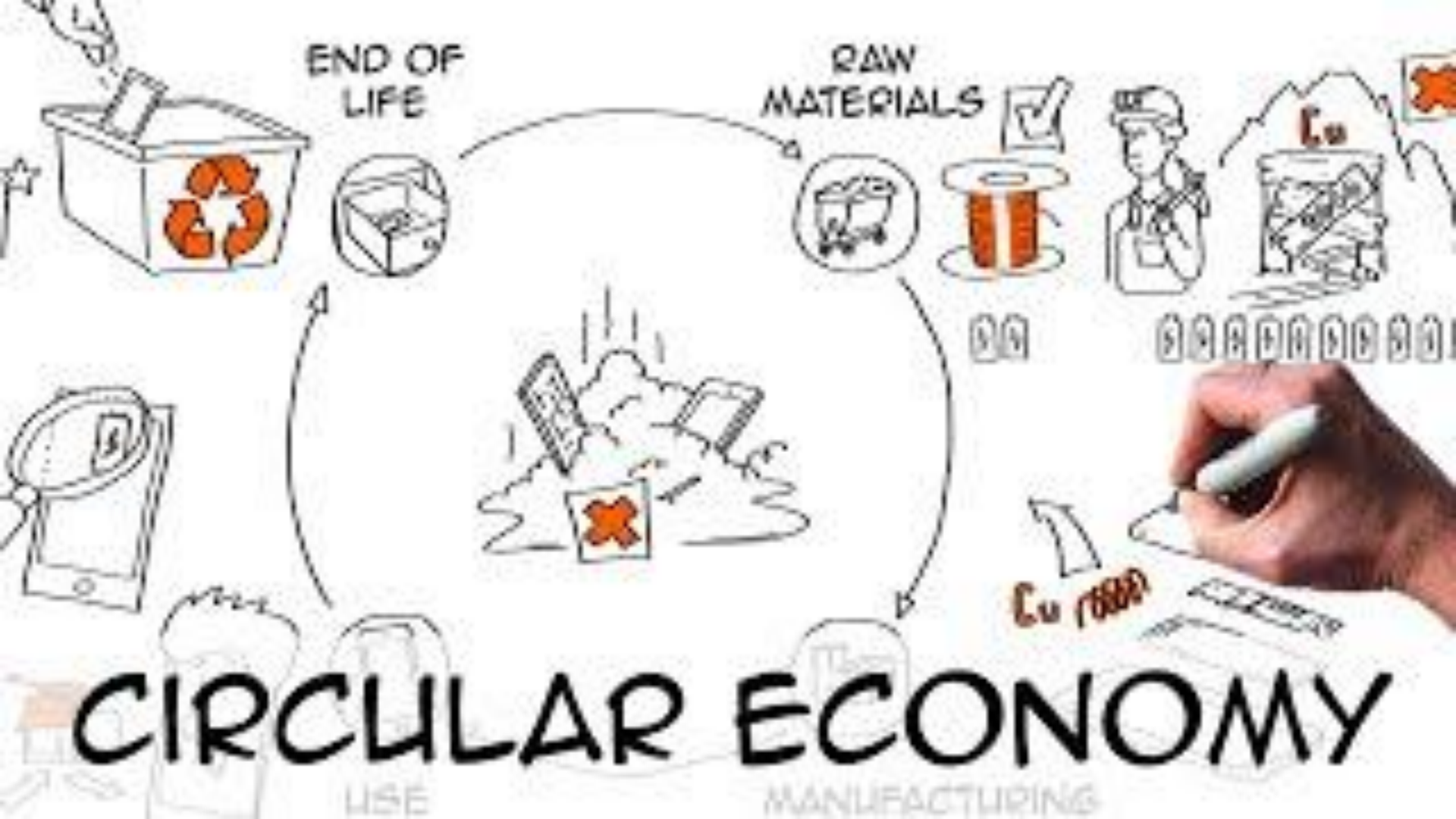
Example: Curitiba, Brazil

- Green space:
  - 52 square meters of green space per person
  - Vs Buenos Aires: 2 square meters per person
- Public transport:
  - Bus Rapid Transport (BRT). 1974. Basis for BRT systems in 300+ cities
  - 70-80% of daily trips for 85% of the population
  - Sometimes every 90 seconds!
  - 2 million per day (compared to London tube system with 3 million)
- Waste:
  - Waste-for-cash program
  - 90% of people take part
  - 4lbs of waste for tokens that can be traded for 1lb of produce.
  - 70% of the waste is recycled.
- Poverty reduction:
  - 30-year economic growth rate is 3.1 percent higher than the national average
  - Per-capita income is 66 percent higher.
  - Over the last 60 years, the population increased by 1,000% to 2 million people


Entrada
Sentido > Santa Cândida
BD106
HD221
REDENTOR
CURITIBA
PARCELE AQUI EM 5X
NOS CARTÕES
"SEM JUROS"
Estação
Central


END OF LIFE
RAW MATERIALS
CIRCULAR ECONOMY
USE
MANUFACTURING

Circular cities: Case studies

Beijing Chaoyang Circular Economy Industrial Park

Clustering industries to reuse each other's byproducts

Electric Vehicle Charging and Battery Swap Station:

Serves sanitation vehicles, electric cars and Dongdong buses. Serves up to 400 vehicles daily.

Restaurant Kitchen Waste Treatment Plant:

Note: food waste is a huge issue in China (70% of waste is food waste, as compared to around 24% in US/Europe)

Largest kitchen waste treatment plant in China. Can process 400 tons of kitchen waste per day. A biochemical treatment technology with high-temperature aerobic fermentation allows to produce 'microbial inoculant' for organic agriculture.

Medical Waste Treatment Plant:

Daily treatment capacity of 30 tons.

Waste Incineration Power Plant:

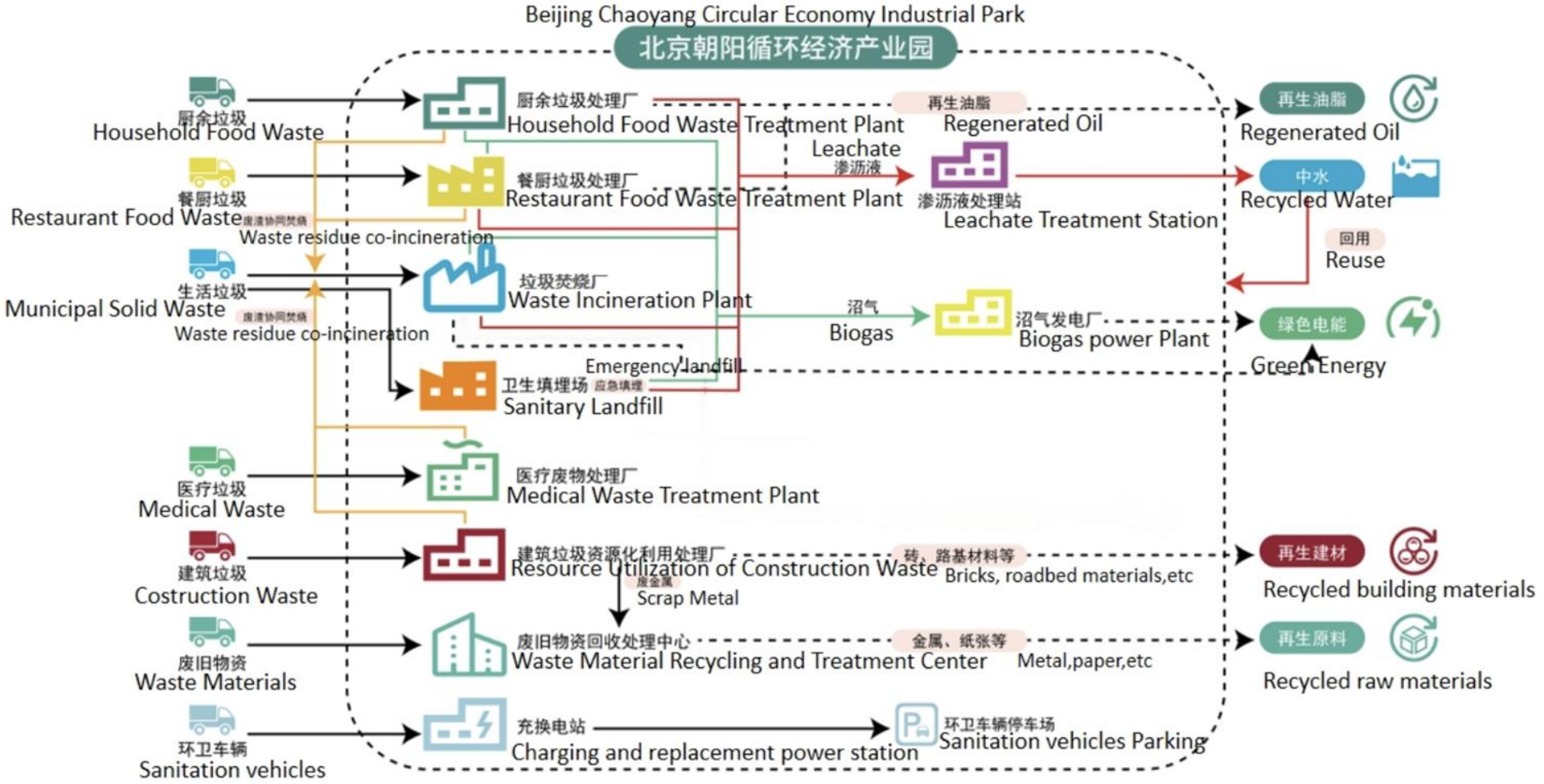
First modern large-scale domestic waste incineration project in Beijing, and also the largest single-line treatment plant in Asia.

Designed daily capacity is 1,600 tons. Annual rated power generation is of 220,000 MWh (about 73,000 houses in Beijing)

Sanitary Landfill:

First large-scale fully-enclosed domestic waste landfill in Beijing.

Total storage capacity of 8.92 million cubic meters and a daily waste disposal capacity of 1,000 tons.


Beijing Chaoyang Circular Economy Industrial Park
北京朝阳循环经济产业园
厨余垃圾
Household Food Waste
厨余垃圾处理厂
Household Food Waste Treatment Plant
再生油脂
Regenerated Oil
Leachate
渗沥液
再生油脂
Regenerated Oil
餐厨垃圾
Restaurant Food Waste
餐厨垃圾处理厂
Restaurant Food Waste Treatment Plant
渗沥液处理站
Leachate Treatment Station
中水
Recycled Water
废渣协同焚烧
Waste residue co-incineration
回用
Reuse
生活垃圾
Municipal Solid Waste
废渣协同焚烧
Waste residue co-incineration
垃圾焚烧厂
Waste Incineration Plant
沼气
Biogas
沼气发电厂
Biogas power Plant
绿色电能
Green Energy
Emergency Landfill
卫生填埋场 应急填埋
Sanitary Landfill
医疗垃圾
Medical Waste
医疗废物处理厂
Medical Waste Treatment Plant
建筑垃圾
Costruction Waste
建筑垃圾资源化利用处理厂
Resource Utilization of Construction Waste
砖、路基材料等
Bricks, roadbed materials,etc
再生建材
Recycled building materials
废金属
Scrap Metal
废旧物资
Waste Materials
废旧物资回收处理中心
Waste Material Recycling and Treatment Center
金属、纸张等
Metal,paper,etc
再生原料
Recycled raw materials
环卫车辆
Sanitation vehicles
充换电站
Charging and replacement power station
环卫车辆停车场
Sanitation vehicles Parking

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Benefits

Producing capacity of green power of 600 million kWh/year

Crude grease of 5,000 tons/year

Renewable resources and renewable products of more than 4,000 tons/day, reducing CO2 emissions by nearly 1.6 million tons per year

Circular cities: Case studies

Cape Town, South Africa

WISP: Western Cape Industrial Symbiosis Programme

Connects businesses with each other to exchange resources!

231 synergies facilitated to date

- Diverted over 143,000 tons of waste from landfill and created over 400 jobs.
- Saved over 435,000 tons C02 emissions (equivalent to 117,840 homes in South Africa)
- Generated $8mil in additional revenue, cost savings, and private investments

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Some examples

Waste wood -> wooden pallets

- Waste management company, wooden pallet company
- Diverted 79 tons of wood waste from landfill, saves the companies money, and keeps virgin wood from being used

Waste egg whites -> confections (sweets)

- Ice cream manufacturer, confectionary company
- Saved on waste disposal costs for the first and made add'l revenue for the second

Organic waste -> insect feed

- Waste management company, insect farming company
- 3,360 tons of organic waste is being sold to feed insects instead of going to a landfill

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Which of the following urban policies align with circular economy goals...while also minimizing unintended environmental harm?

Why?

B. Local material reuse hubs support the circular economy by facilitating the reuse of construction materials, reducing the demand for virgin resources.

D. Take-back programs for electronics encourage recycling and proper disposal, aligning with circular economy principles.

A. While promoting electric vehicles can reduce emissions, it doesn't directly address material reuse or waste reduction.

C. Waste-to-energy incineration can reduce landfill use but may discourage recycling and doesn't promote material reuse.

TechUK

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According to recent data, which sector is most frequently underestimated in urban sustainability plans despite having a high impact on emissions and resource consumption?

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Why?

The construction sector, including building operations, significantly contributes to urban emissions and resource consumption. However, its impact is often underestimated in sustainability planning.

ScienceDirect

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A city introduces green roofs across all municipal buildings. Which of the following should be considered to assess whether this contributes meaningfully to long-term environmental sustainability?

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Why?

Evaluating the sustainability of green roofs involves considering maintenance capabilities, the environmental impact of construction materials, and ecological benefits like biodiversity enhancement and stormwater management.

US EPA

ScienceDirect

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A city council is debating between two proposals: (1) subsidize compost bins for every household, or (2) invest in a large-scale anaerobic digestion facility. Both address organic waste. What trade-off most accurately describes their difference in long-term sustainability strategy?

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Why?

Household composting encourages individual behavior change and community engagement, while anaerobic digestion offers a scalable solution for organic waste management but may involve less direct public participation.

ScienceDirect

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Which of these challenges often arises when applying circular economy frameworks in cities in the Global South?

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Why?

In many Global South cities, the informal sector plays a crucial role in waste management. However, circular economy initiatives often overlook integrating these informal systems, leading to challenges in implementation.

circle-economy.com

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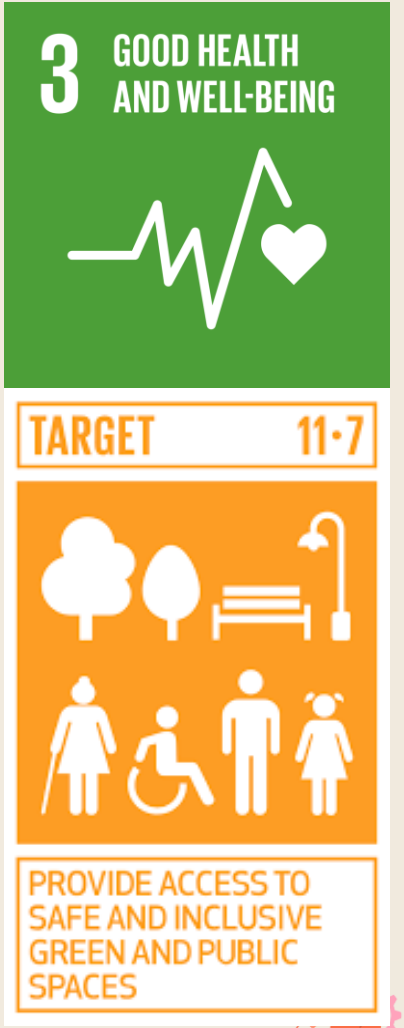
Green spaces = healthier people

How do they help?

- Cooler temperatures
- More (and hopefully safer) exercise
- Nature decreases stress and depression
- Place for children to play
- Decreased air pollution
  - Fewer cars
  - Plants produce oxygen and filter out air pollutants for better air quality
- Less isolation and more social inclusivity
- Less noise pollution
- Opportunities for urban gardens

**Participatory planning is important!

https://unhabitat.org/sites/default/files/2025/01/final_public_space_and_urban_health.pdf
https://iris.who.int/bitstream/handle/10665/345751/WHO-EURO-2016-3352-43111-60341-eng.pdf



Who benefits more from these?

Photo by Laurentiu Morariu on Unsplash

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Studies have shown…

Housewives–and women in general

- Shown to have less stress
- However, may worry more about safety if not designed well–BUT better than exercising on streets, where harassment is more often.
- Pregnant women (reduced blood pressure, reduced depressed, especially for women from disadvantaged groups)

Older people at risk of isolation and less exercise–social ties and community.

Children, who otherwise may not have the option to socialize in a safe space–and with different cultures.

Adolescents

Important to think about the use of space: if all the "play" space is focused on sports that are more traditionally focused on boys (basketball, football), then girls won't feel like it's a space for them.

"Deprived subpopulations and minority groups"

Reduced psychological distress in a deprived urban population in the US
Socioeconomic inequality in mental-wellbeing was 40% narrower among respondents reporting good access to green space
Often have lack of access to cooling systems, so the role of vegetation on cooling urban areas is more important for the urban poor

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Group work:

What is your city doing particularly well around sustainability/circular systems/green space?

What is something they should do better? What would have the most impact, particularly for more vulnerable groups?

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Report out

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Next week:

- Resilience in urban design

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Sustainable and Inclusive Cities

June 2025
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Agenda: Session 5 (Resilience + Final Project)

5 min	Ice breaker
15 min	*Discussion:* What is a resilient city?
5 min	The effects of climate change on cities
10 min	Case studies
15 min	Guest speaker
5 min	STEM careers in sustainable and inclusive cities
20 min	Small group discussions
10 min	Report out
5 min	Post-survey

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Ice breaker

- Name
- School
- Major and year
- What would be your dream job and why?

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What’s a resilient city?

Ability to bounce back from and adapt to various shocks and stresses, such as natural disasters, economic downturns, and social challenges (https://www.e-zigurat.com/en/blog/urban-resilience-sustainable-cities/)

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The effects of climate change on cities

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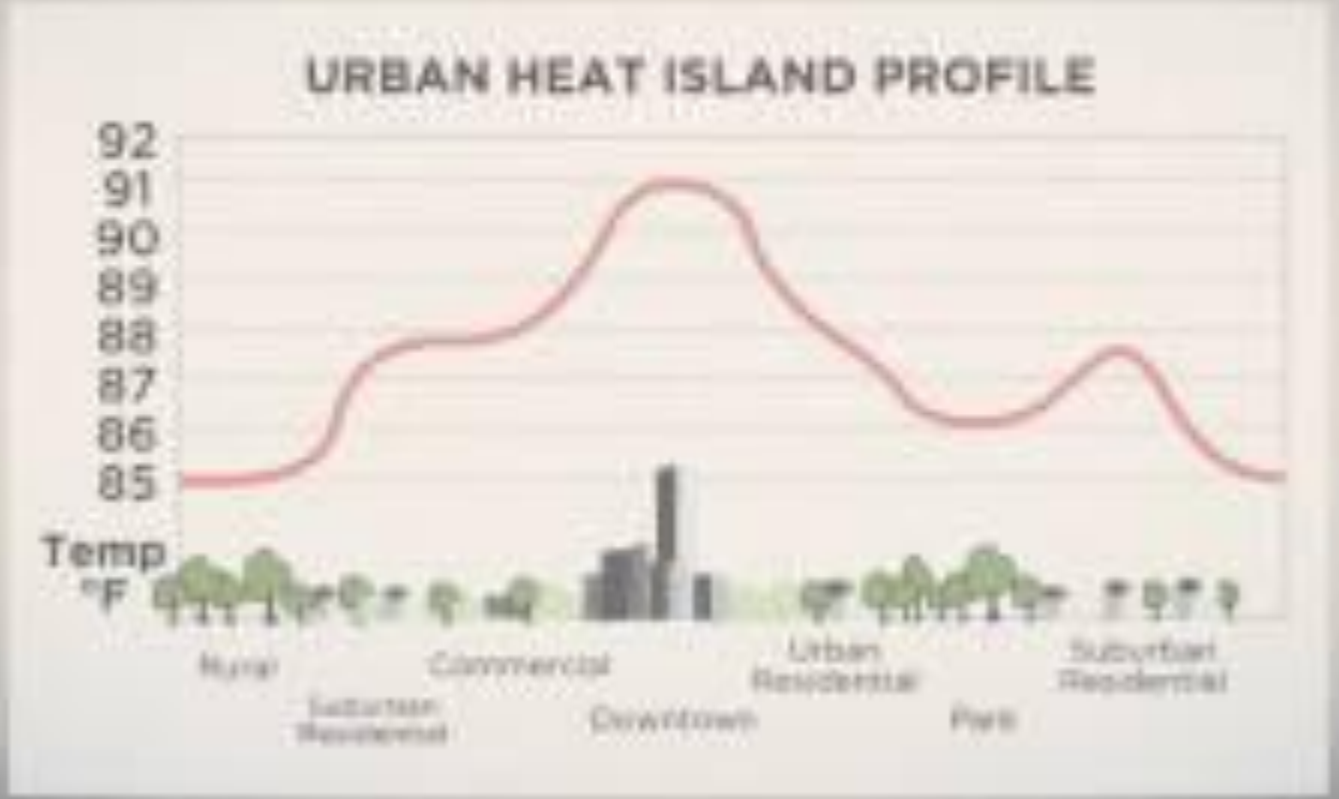
Cities: Key impacts



NOAA

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Pathways to resilient cities

1. **Integrate Mitigation and Adaptation:** actions that reduce greenhouse gas emissions while increasing resilience are a win-win.

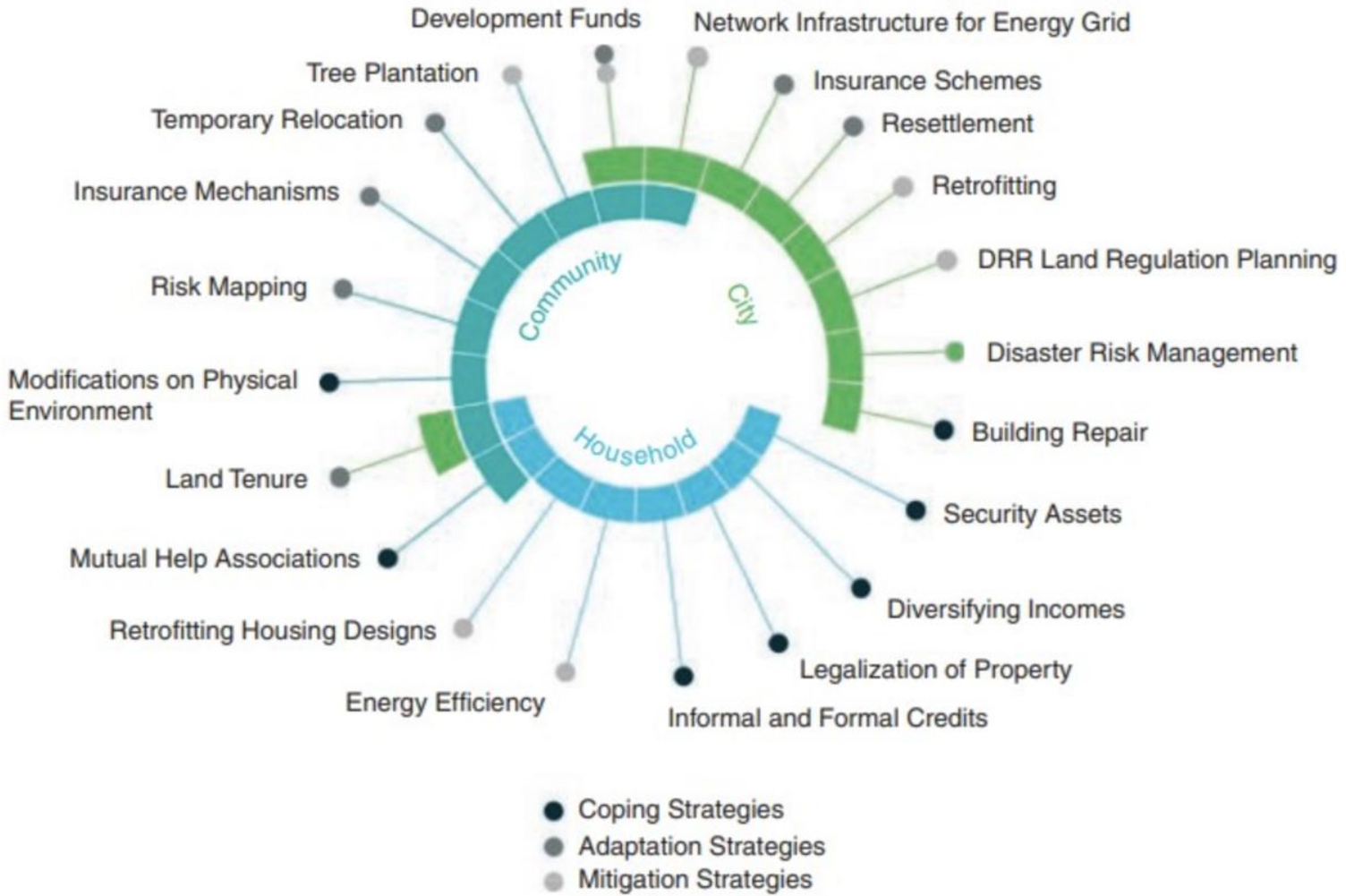
2. **Coordinate Disaster Risk Reduction and Climate Change Adaptation:** Disaster risk reduction and climate change adaptation are the cornerstones of resilient cities.

3. **Co-generate Risk Information:** Risk assessments and climate action plans co-generated with a full range of stakeholders and scientists are most effective.

4. **Focus on Disadvantaged Populations:** Needs of disadvantaged and vulnerable citizens should be addressed in climate change planning and action.

5. **Advance Governance, Finance, and Knowledge Networks:** Developing robust city institutions, advancing city creditworthiness, and participating in city research and action networks enable climate action.

From: https://www.uccrn.education/what-is-the-meaning-of-resilient-city/


Development Funds
Network Infrastructure for Energy Grid
Tree Plantation
Insurance Schemes
Temporary Relocation
Resettlement
Insurance Mechanisms
Retrofitting
DRR Land Regulation Planning
Risk Mapping
Community
City
Disaster Risk Management
Modifications on Physical Environment
Household
Building Repair
Land Tenure
Security Assets
Mutual Help Associations
Diversifying Incomes
Retrofitting Housing Designs
Legalization of Property
Energy Efficiency
Informal and Formal Credits
Coping Strategies
Adaptation Strategies
Mitigation Strategies

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Earthquake readiness in Wellington, New Zealand

Problems addressed:

On top of a fault line (earthquakes, tidal flooding, storm surge)

Effects of those on buildings, electricity, and drinkable water

- Empowered residents through a participatory planning and budgeting process (not just focused on climate resilience!)
- Retrofitted 113 buildings and upgrading another 600
- Surcharge to pay for upgrading their power network to withstand disasters
- Constructed 22 river-fed emergency drinking water locations (if an earthquake ruptures underground pipes–will provide more than 200,000 people with a secure water supply and ensure that residents will not have to walk more than 1 kilometer to get access to drinking water.

https://resilientcitiesnetwork.org/downloadable_resources/UR/100-Resilient-Cities-Midterm-Evaluation-Report-Case-Studies.pdf

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Green bus stops in Poland

Problems addressed:

Urban heat island effect

Excess of rainwater runoff

Livability (green space!)

https://stateofgreen.com/en/news/12-examples-of-climate-resilient-city-solutions/

Other case studies

Bangkok, Thailand

Key resilience themes

- Flood management
- Informal settlements
- Green infrastructure

Resilience strategies

- Bangkok Resilience Strategy focuses on aging infrastructure, floods, and social fragmentation
- Urban Flood Resilience Project combines green infrastructure and drainage upgrades
- Community Resilience Networks enable grassroots capacity-building and early warning systems

Impact: Blends infrastructure with social systems to address chronic shocks and stresses

Medellín, Colombia

Key resilience themes

- Social inclusion
- Mobility
- Climate adaptation

Resilience strategies

- Metrocable public transit system connects marginalized hillside neighborhoods to the city center
- Green Corridors program adds green space and reduces the urban heat island effect
- Participatory urban planning involves residents in decisions on land use and infrastructure

Impact: Transformed from a violent city into a model of urban innovation and resilience

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STEM careers in sustainable and inclusive cities

Document

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Guest speaker

[name]

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https://bit.ly/sustainable-cities-folder

Group work:

Using your previous solution(s) and what you know now, pull it all together in an environmentally sustainable (and resilient) way to create a proposal that you feel hits all the main points.

- What is your final solution?
- What are the pros and cons of your solution?
  - What positive/negative effects does it have on the environment?
  - Is it resilient?
  - Who might be left behind?
  - How can you keep them from being left behind?

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Report out

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https://bit.ly/designing-sustainable-cities-wsu-survey

Survey

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Thank you!

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