Sustainable and Inclusive Cities:

Environmental Sustainability and the Circular Economy in Urban Design

June 2025

Instructor: Janice Levenhagen

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 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?

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!

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CREATING SUSTAINABLE CITIES

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

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Entrada
Sentido > Santa Cândida
SOS
CURSOS DE COMUNICAÇÃO
PARCELE AQUI EM 5X
NOS CARTÕES
"SEM JUROS"
CORREIOS
BD105
AFK-3152
HD221
REDENTOR
CURITIBA
AFK-3032
Estação Central

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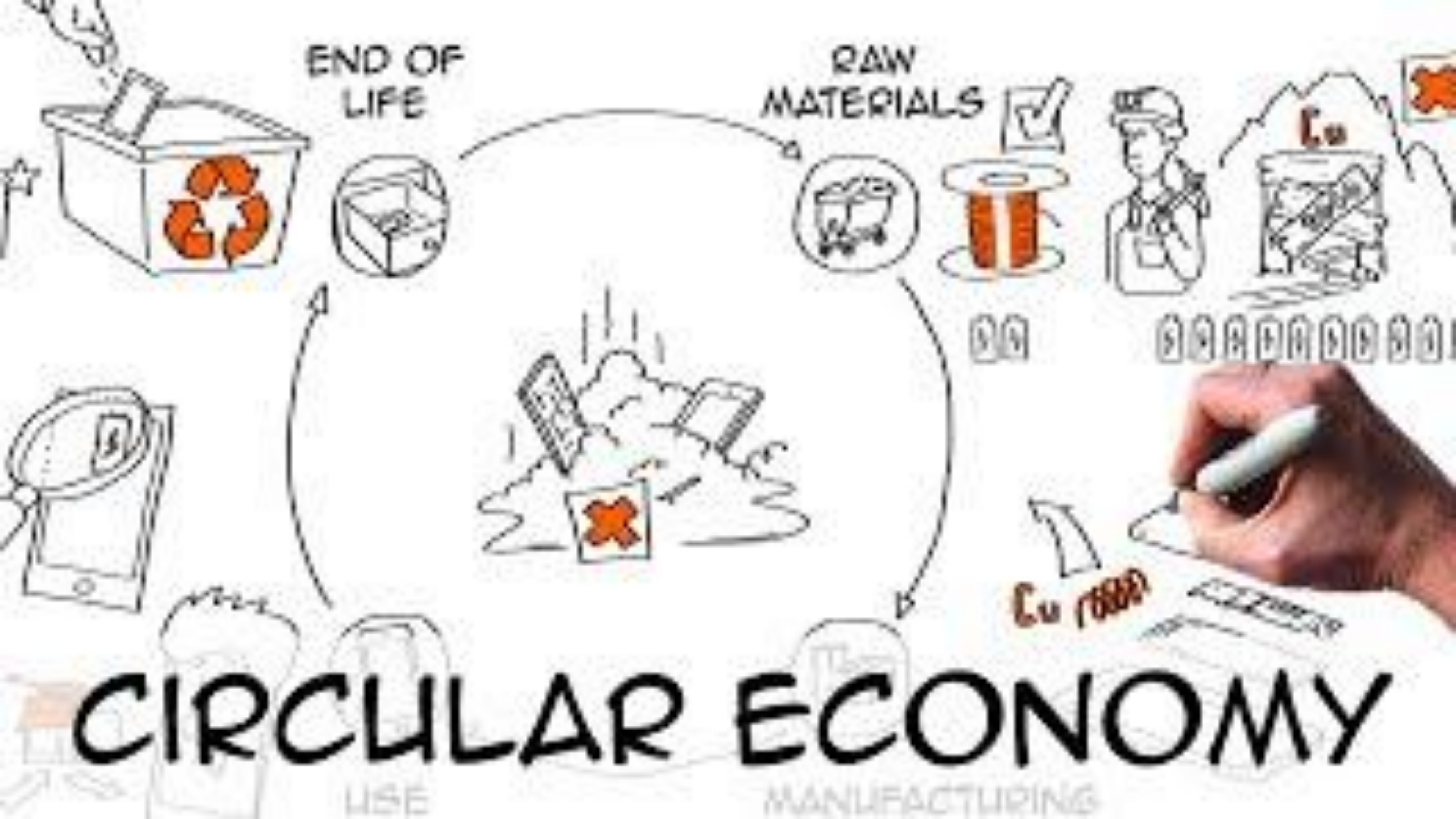

END OF LIFE
RAW MATERIALS
Cu
Cu (1888)
USE
MANUFACTURING
CIRCULAR ECONOMY

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)

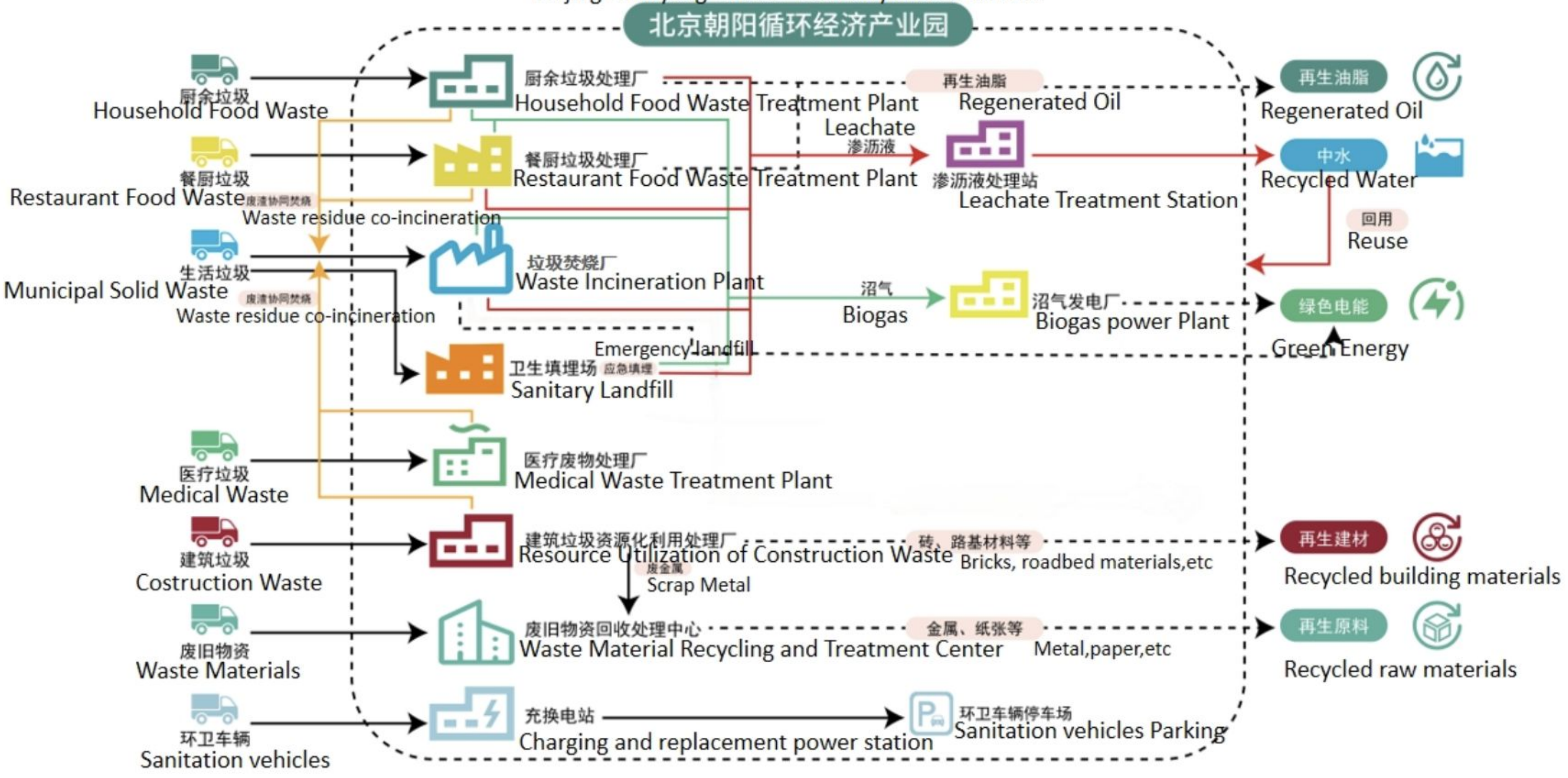
Sanitary Landfill:

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

餐厨垃圾
Restaurant Food Waste

废渣协同焚烧
Waste residue co-incineration

生活垃圾
Municipal Solid Waste

废渣协同焚烧
Waste residue co-incineration

医疗垃圾
Medical Waste

建筑垃圾
Costruction Waste

废旧物资
Waste Materials

环卫车辆
Sanitation vehicles

厨余垃圾处理厂
Household Food Waste Treatment Plant

餐厨垃圾处理厂
Restaurant Food Waste Treatment Plant

垃圾焚烧厂
Waste Incineration Plant

卫生填埋场
Sanitary Landfill

应急填埋
Emergency landfill

医疗废物处理厂
Medical Waste Treatment Plant

建筑垃圾资源化利用处理厂
Resource Utilization of Construction Waste

废金属
Scrap Metal

废旧物资回收处理中心
Waste Material Recycling and Treatment Center

充换电站
Charging and replacement power station

再生油脂
Regenerated Oil

渗沥液
Leachate

渗沥液处理站
Leachate Treatment Station

沼气
Biogas

沼气发电厂
Biogas power Plant

砖、路基材料等
Bricks, roadbed materials,etc

金属、纸张等
Metal,paper,etc

环卫车辆停车场
Sanitation vehicles Parking

再生油脂
Regenerated Oil

中水
Recycled Water

回用
Reuse

绿色电能
Green Energy

再生建材
Recycled building materials

再生原料
Recycled raw materials

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 CO_2 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

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

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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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How to change the design

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?

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.

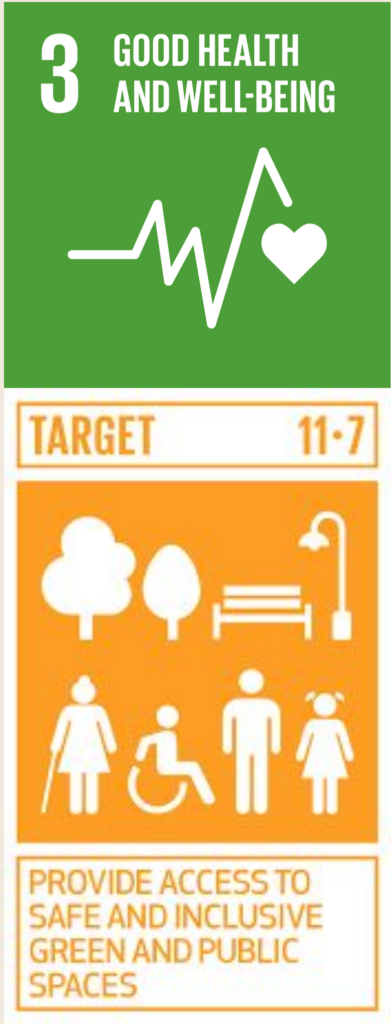
circle-economy.com

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!


3
GOOD HEALTH AND WELL-BEING
TARGET
11·7
PROVIDE ACCESS TO SAFE AND INCLUSIVE GREEN AND PUBLIC SPACES

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

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Who benefits more from these?

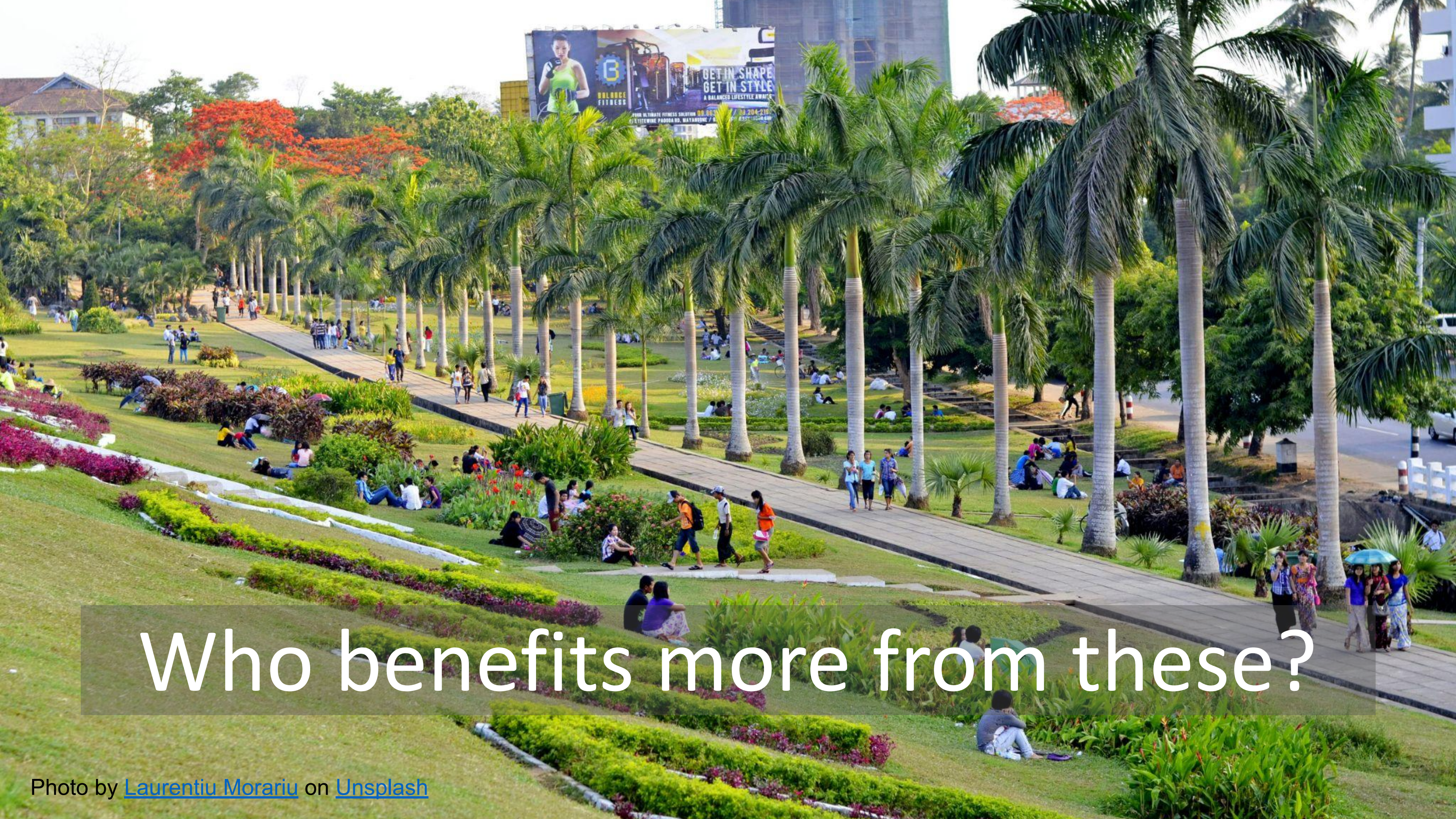
GET IN SHAPE
GET IN STYLE
BALANCE FITNESS

Photo by Laurentiu Morariu on Unsplash

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?

Report out

Next week:

- Resilience in urban design

Thank you and see you soon!

Sustainable and Inclusive Cities: Smart Cities

June 2025
Instructor: Janice Levenhagen

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UNIVERSITY OF THESSALY
STIMMULI for social change
NTNU Norwegian University of Science and Technology
DIGITAL LEADERSHIP INSTITUTE WOMEN STEM UP

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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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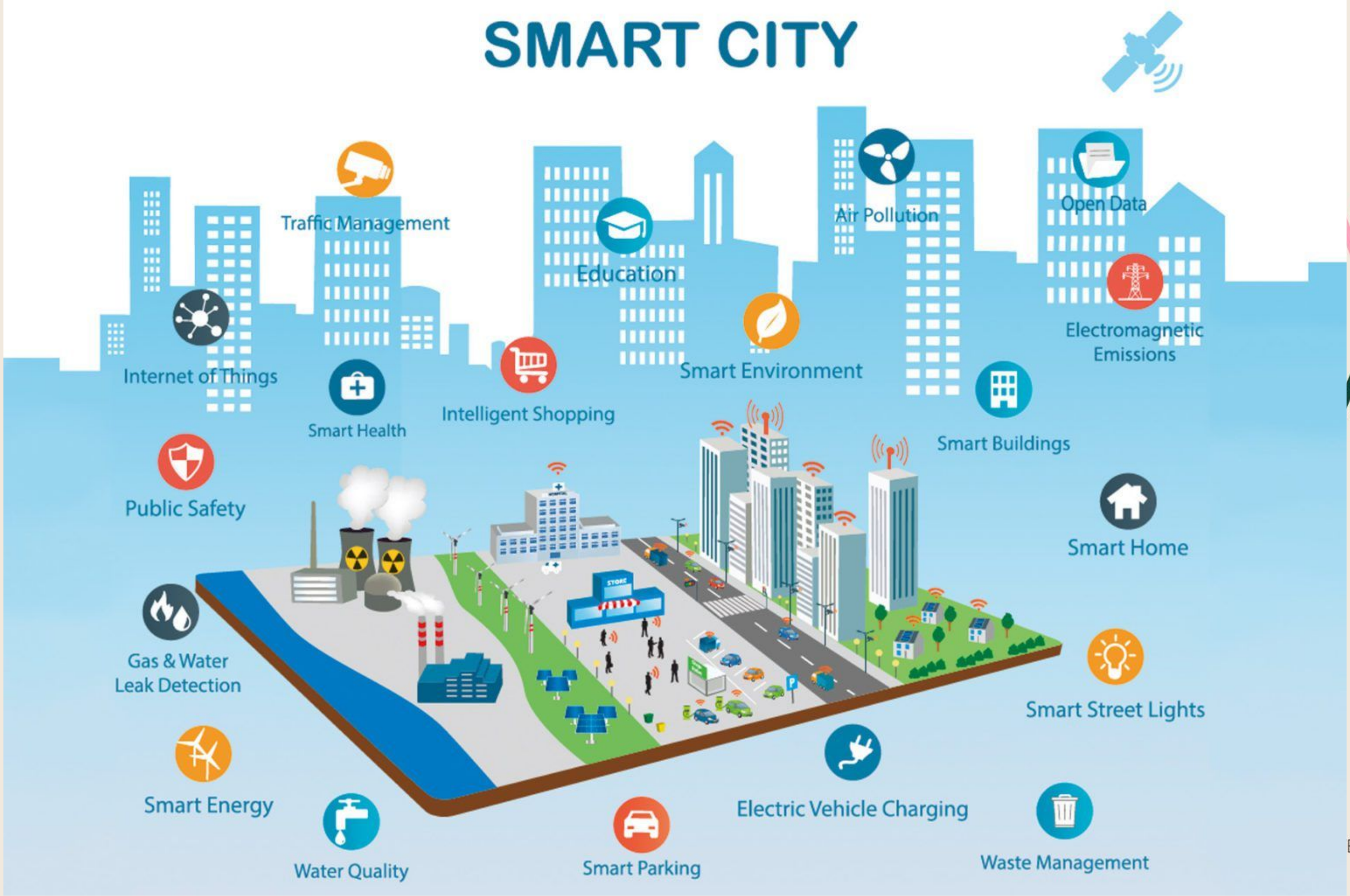
Review: What’s a smart city?

Smart
Cities
SHIFT

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


SMART CITY
Traffic Management
Education
Air Pollution
Open Data
Internet of Things
Smart Health
Intelligent Shopping
Smart Environment
Electromagnetic Emissions
Smart Buildings
Public Safety
Smart Home
Gas & Water Leak Detection
Smart Street Lights
Smart Energy
Water Quality
Smart Parking
Electric Vehicle Charging
Waste Management
STORE

EM UP

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

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

“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”

AGAIN: must be people-centric and participatory!

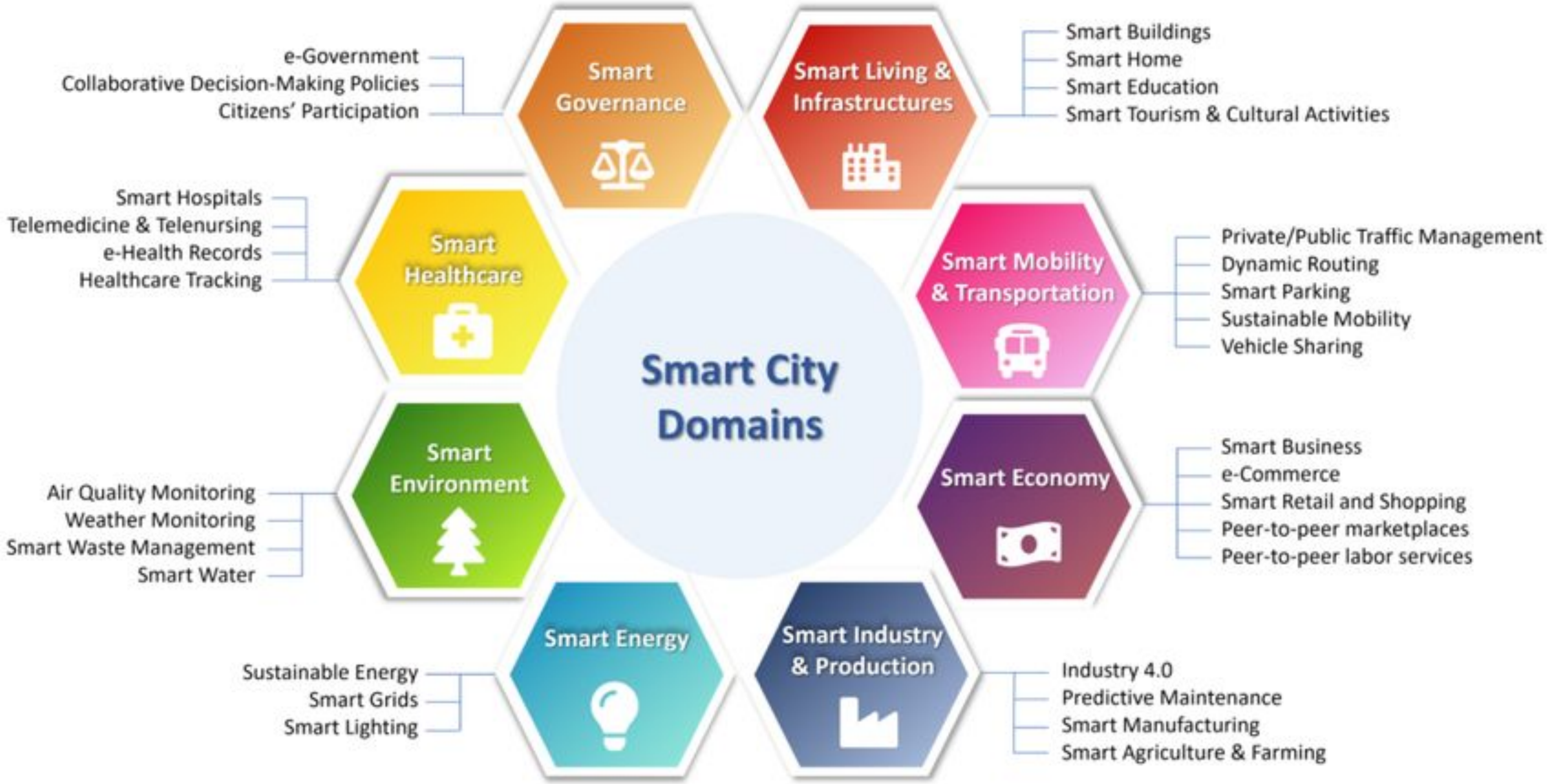
Smart City Domains
Smart Governance
e-Government
Collaborative Decision-Making Policies
Citizens' Participation
Smart Living & Infrastructures
Smart Buildings
Smart Home
Smart Education
Smart Tourism & Cultural Activities
Smart Healthcare
Smart Hospitals
Telemedicine & Telenursing
e-Health Records
Healthcare Tracking
Smart Mobility & Transportation
Private/Public Traffic Management
Dynamic Routing
Smart Parking
Sustainable Mobility
Vehicle Sharing
Smart Environment
Air Quality Monitoring
Weather Monitoring
Smart Waste Management
Smart Water
Smart Economy
Smart Business
e-Commerce
Smart Retail and Shopping
Peer-to-peer marketplaces
Peer-to-peer labor services
Smart Energy
Sustainable Energy
Smart Grids
Smart Lighting
Smart Industry & Production
Industry 4.0
Predictive Maintenance
Smart Manufacturing
Smart Agriculture & Farming

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?

WOMEN STEM UP

Report out

BREAK

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

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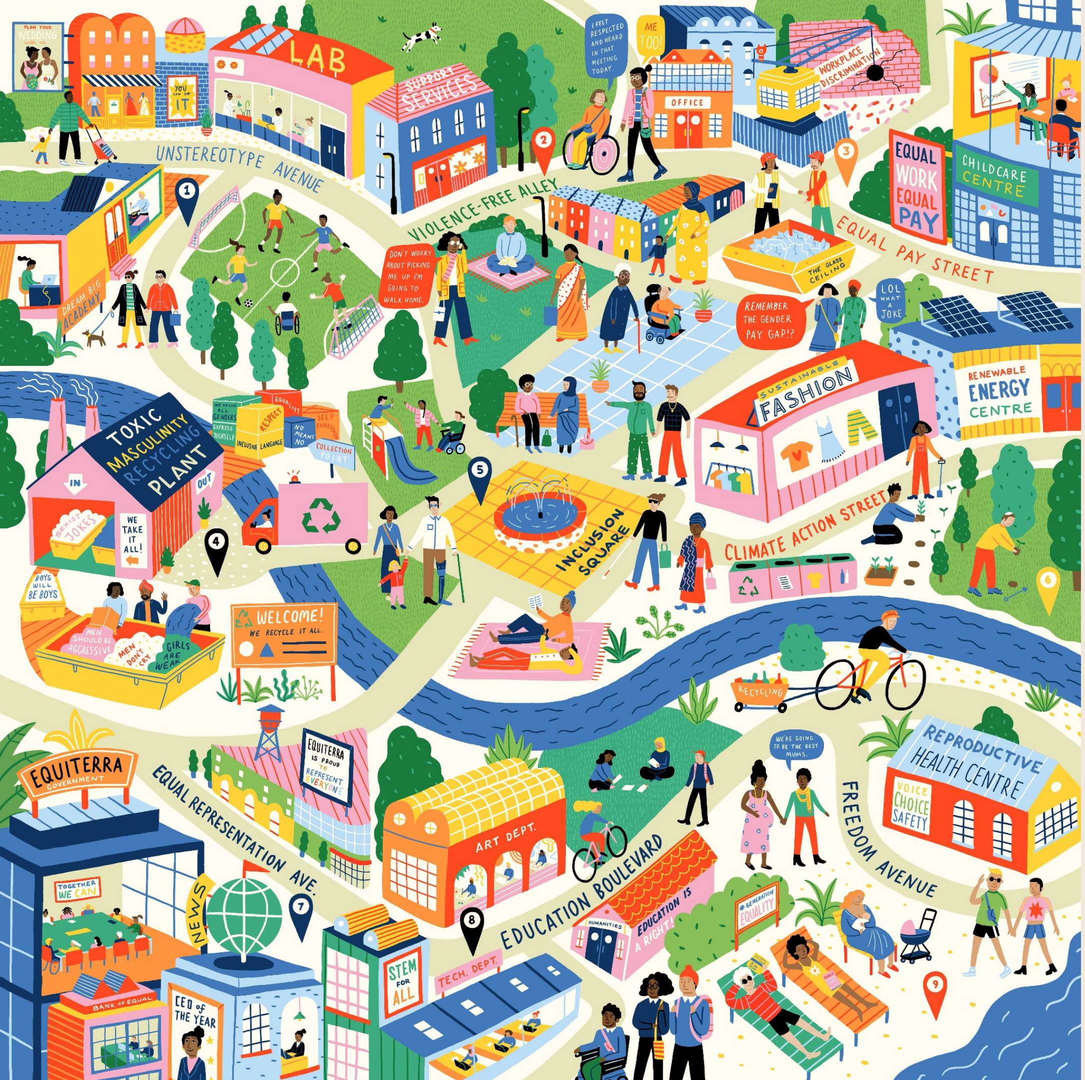
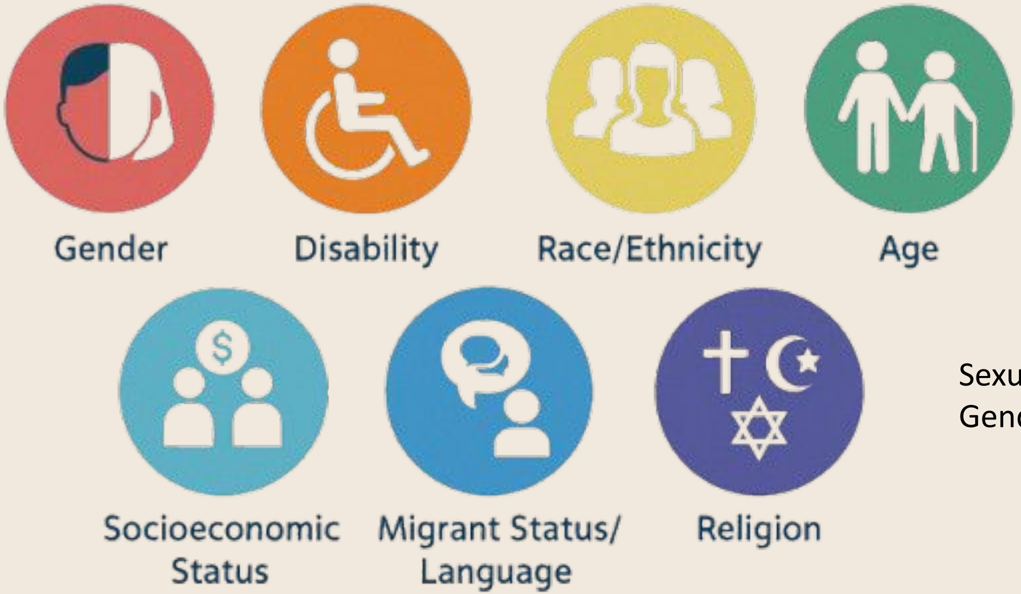

PLAN YOUR WEDDING
LAB
SUPPORT SERVICES
YOU CAN DO IT
I FELT RESPECTED AND HEARD IN THAT MEETING TODAY.
ME TOO!
OFFICE
WORKPLACE DISCRIMINATION
UNSTEREOTYPE AVENUE
1
2
3
VIOLENCE-FREE ALLEY
EQUAL WORK EQUAL PAY
CHILDCARE CENTRE
EQUAL PAY STREET
THE GLASS CEILING
DON'T WORRY ABOUT PICKING ME UP I'M GOING TO WALK HOME.
DREAM BIG ACADEMY
REMEMBER THE GENDER PAY GAP!?
LOL WHAT A JOKE
TOXIC MASCULINITY RECYCLING PLANT
WE VALUE ALL GENDERS
EXPRESS YOURSELF
INCLUSIVE LANGUAGE
RESPECT
EQUALITY
SELF EXPRESSION
NO MEANS NO
COLLECTION POINT
SUSTAINABLE FASHION
RENEWABLE ENERGY CENTRE
IN
OUT
SEXIST JOKES
WE TAKE IT ALL!
4
5
INCLUSION SQUARE
CLIMATE ACTION STREET
6
BOYS WILL BE BOYS
WELCOME! WE RECYCLE IT ALL.
MEN SHOULD BE AGGRESSIVE
MEN DON'T CRY
GIRLS ARE WEAK
RECYCLING
EQUITERRA GOVERNMENT
EQUITERRA IS PROUD TO REPRESENT EVERYONE
EQUAL REPRESENTATION AVE.
WE'RE GOING TO BE THE BEST MUMS.
REPRODUCTIVE HEALTH CENTRE
VOICE CHOICE SAFETY
FREEDOM AVENUE
ART DEPT.
EDUCATION BOULEVARD
EDUCATION IS A RIGHT!
HUMANITIES
#GENERATION EQUALITY
TOGETHER WE CAN
NEWS
7
8
9
STEM FOR ALL
TECH. DEPT.
BANK OF EQUAL
CEO OF THE YEAR

[Equiterra](https://un-women.medium.com/welcome-to-equiterra-where-gender-equality-is-real-6fc832c383fe), 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

Who are affected differently by cities?


Gender
Disability
Race/Ethnicity
Age
Socioeconomic Status
Migrant Status/ Language
Religion

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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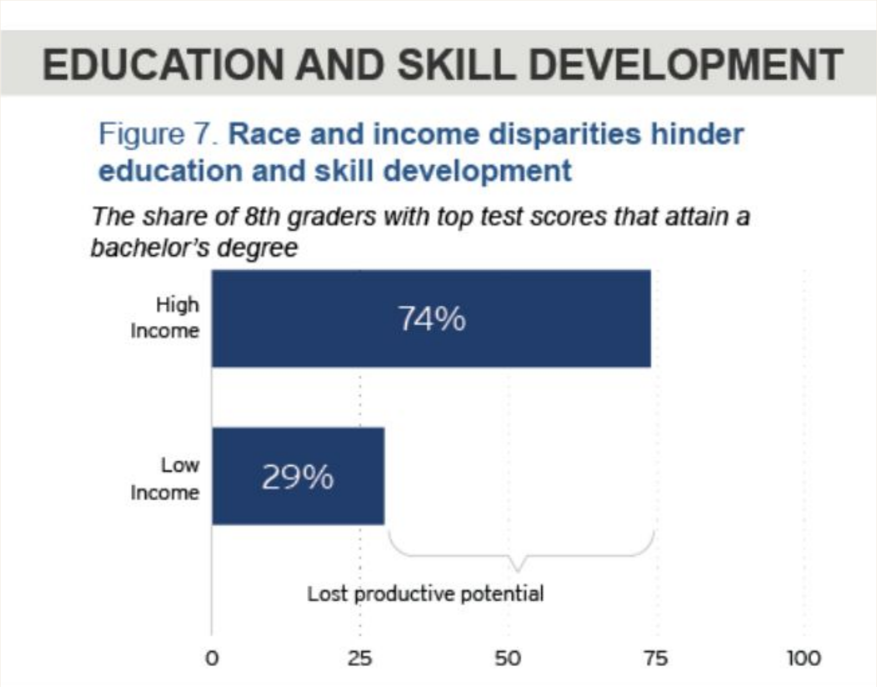
Case study: the cost of unequal economic opportunity



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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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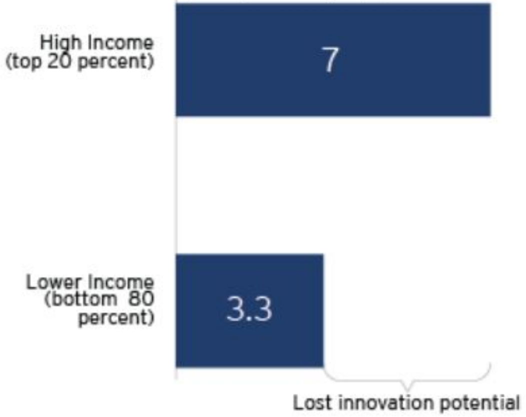
Case study: the cost of unequal economic opportunity

INNOVATION

Figure 9. **Inequality of opportunity impairs innovation potential**

Patent rates as adults among 3rd graders with mathematics test scores in top 10 percent, by parental income



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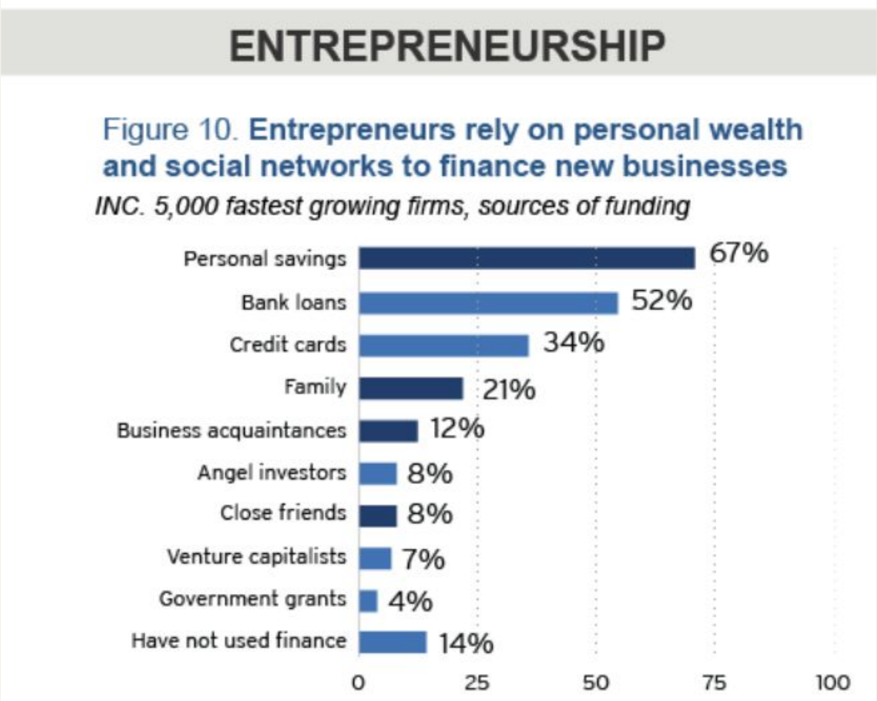
Case study: the cost of unequal economic opportunity



ENTREPRENEURSHIP

Figure 10. **Entrepreneurs rely on personal wealth and social networks to finance new businesses**

INC. 5,000 fastest growing firms, sources of funding

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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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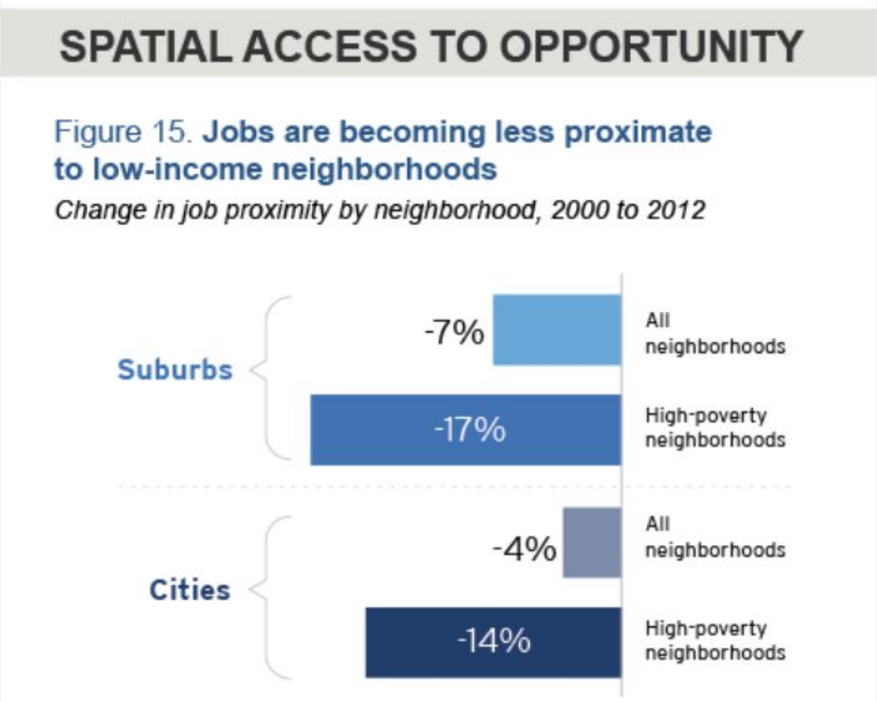
Case study: the cost of unequal economic opportunity



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Case study: the cost of unequal economic opportunity (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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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

Co-funded by the European Union

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

Co-funded by the European Union

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

Co-funded by the European Union

Case Study: Women’s safety audits

Findings

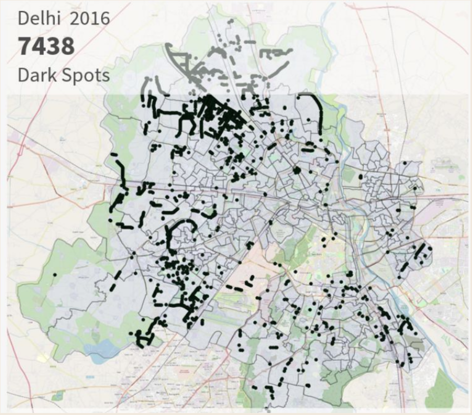
- Insensitive attitudes of the police and public transport staff including drivers and conductors
- Gaps in provision and effectiveness of essential services (access to telephone booths, police and 24-hour hospitals)
- Poor lighting near bus stops (and in general a need for more street lighting infrastructure)
- 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

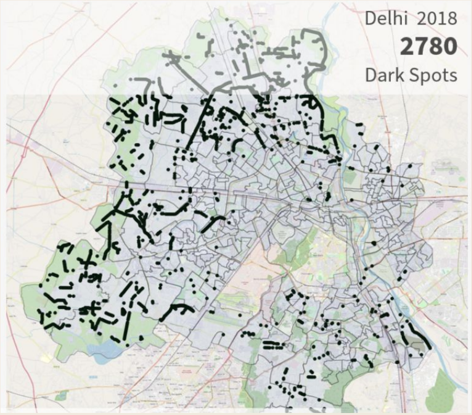
Technology: Safetipin

Co-funded by the European Union

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

Co-funded by the European Union
WOMEN STEM UP

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

Co-funded by
the European Union

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

Co-funded by
the European Union

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).

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

Report out

Next week:

- Smart cities
- Sustainability and the circular economy

Thank you and see you soon!

Sustainable and Inclusive Cities

June 2025
Instructor: Janice Levenhagen, Katja Legisa

LINKÖPING UNIVERSITY
UNIVERSITY OF THESSALY
STIMMULI for social change
NTNU Norwegian University of Science and Technology
DIGITAL LEADERSHIP INSTITUTE WOMEN STEM UP

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

Co-funded by the European Union

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 Greece), you could be chosen to attend a 3-day hackathon in Greece!

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the European Union

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!****

Co-funded by the European Union

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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the European Union

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?

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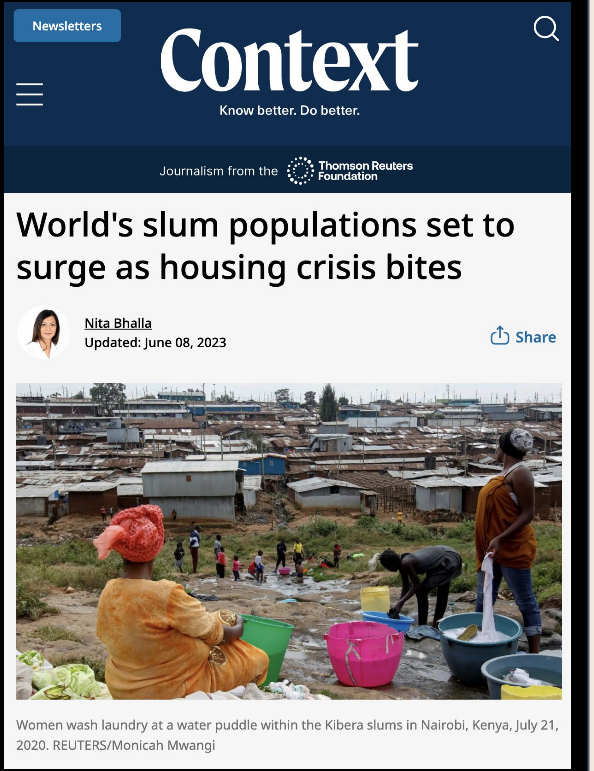
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Context
Know better. Do better.
Journalism from the Thomson Reuters Foundation

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

Nita Bhalla
Updated: June 08, 2023

Share

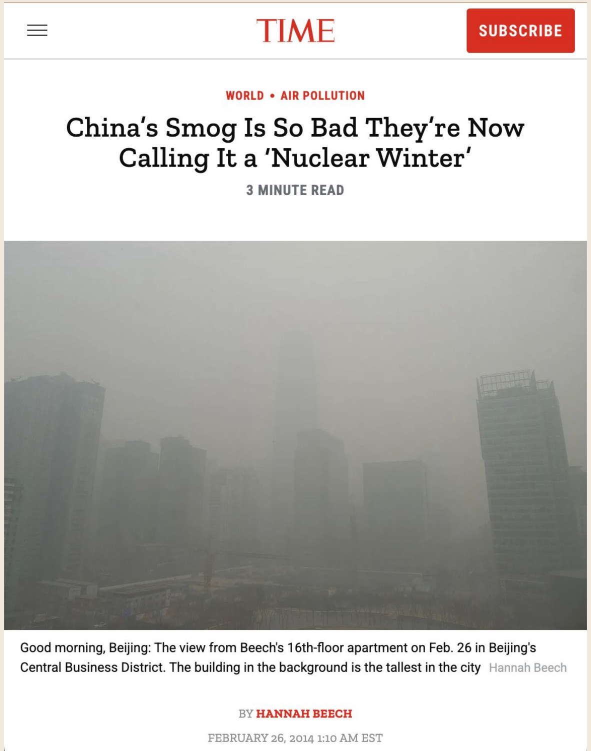
Women wash laundry at a water puddle within the Kibera slums in Nairobi, Kenya, July 21, 2020. REUTERS/Monicah Mwangi

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

Informal settlements

Air pollution

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


TIME
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WORLD • AIR POLLUTION

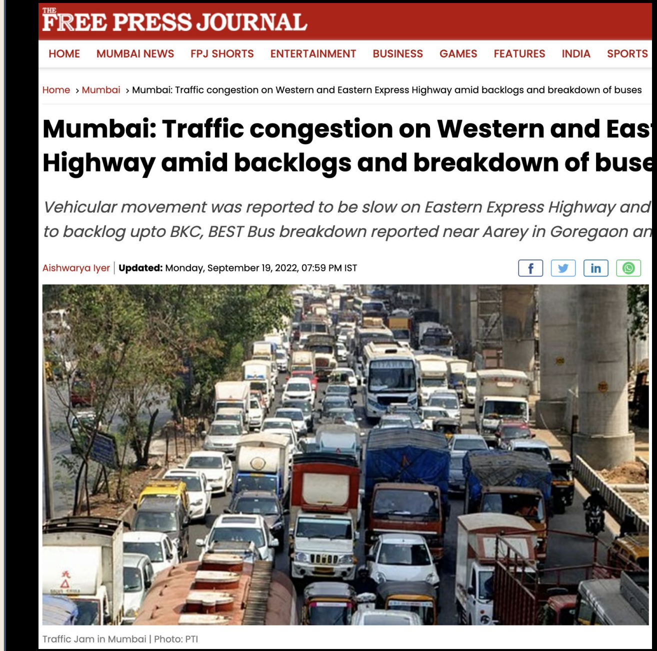
China's Smog Is So Bad They're Now Calling It a 'Nuclear Winter'

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 Eas
Highway amid backlogs and breakdown of buse

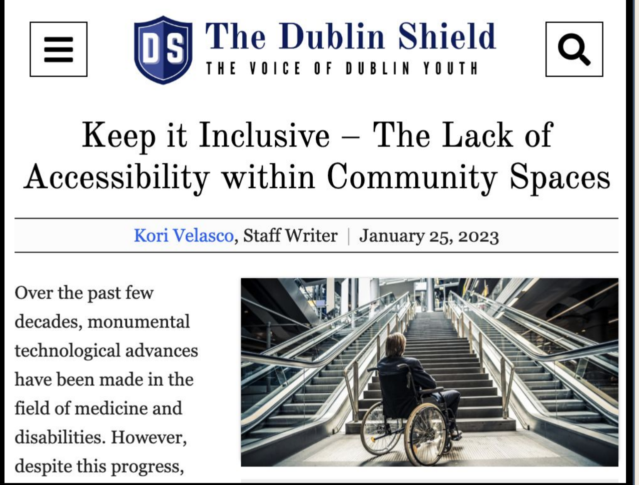
Vehicular movement was reported to be slow on Eastern Express Highway and
to backlog upto BKC, BEST Bus breakdown reported near Aarey in Goregaon an

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

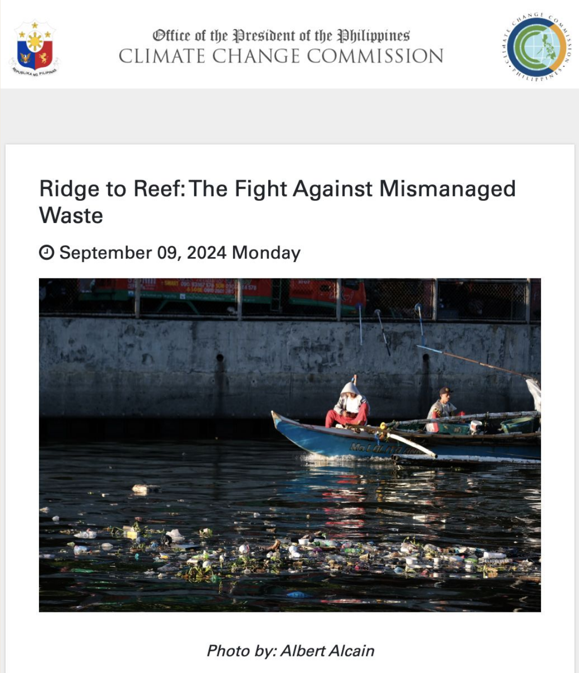
Over the past few decades, monumental technological advances have been made in the field of medicine and disabilities. However, despite this progress,

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

Inaccessible public spaces

Poor waste management

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

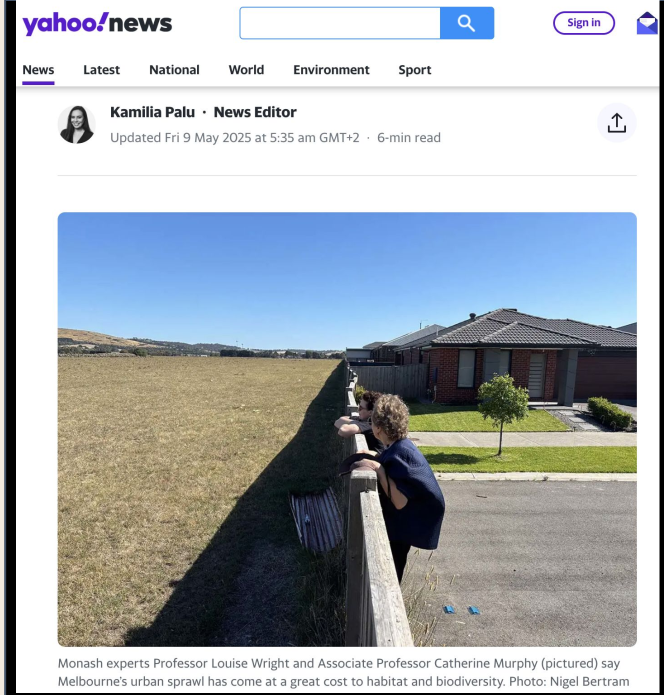


Office of the President of the Philippines
CLIMATE CHANGE COMMISSION

Ridge to Reef: The Fight Against Mismanaged Waste

September 09, 2024 Monday

Photo by: Albert Alcain



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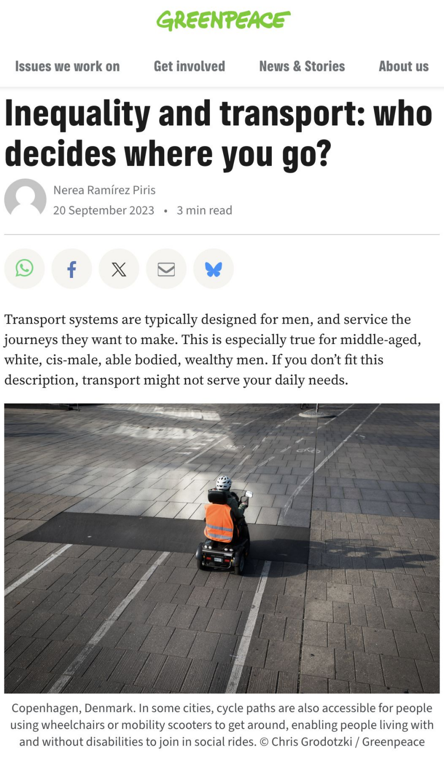
Kamilia Palu · News Editor

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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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.

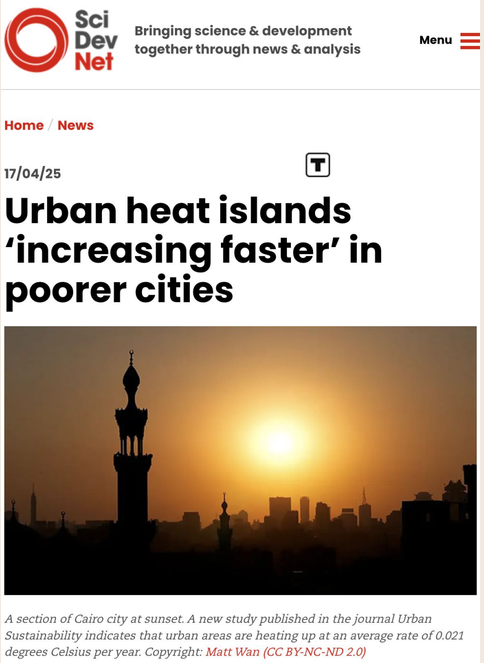
Copenhagen, Denmark. In some cities, cycle paths are also accessible for people using wheelchairs or mobility scooters to get around, enabling people living with and without disabilities to join in social rides. © Chris Grodotzki / Greenpeace

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

Inequitable transport systems

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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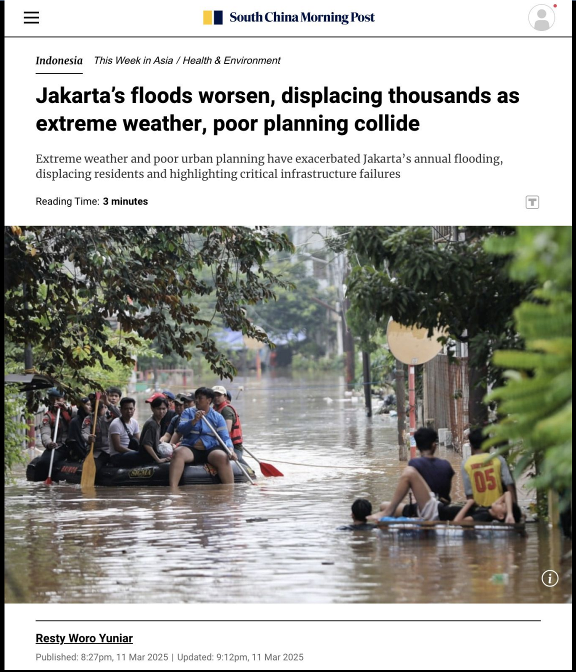
17/04/25

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

Why is this important?

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How to change the design

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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Do not edit
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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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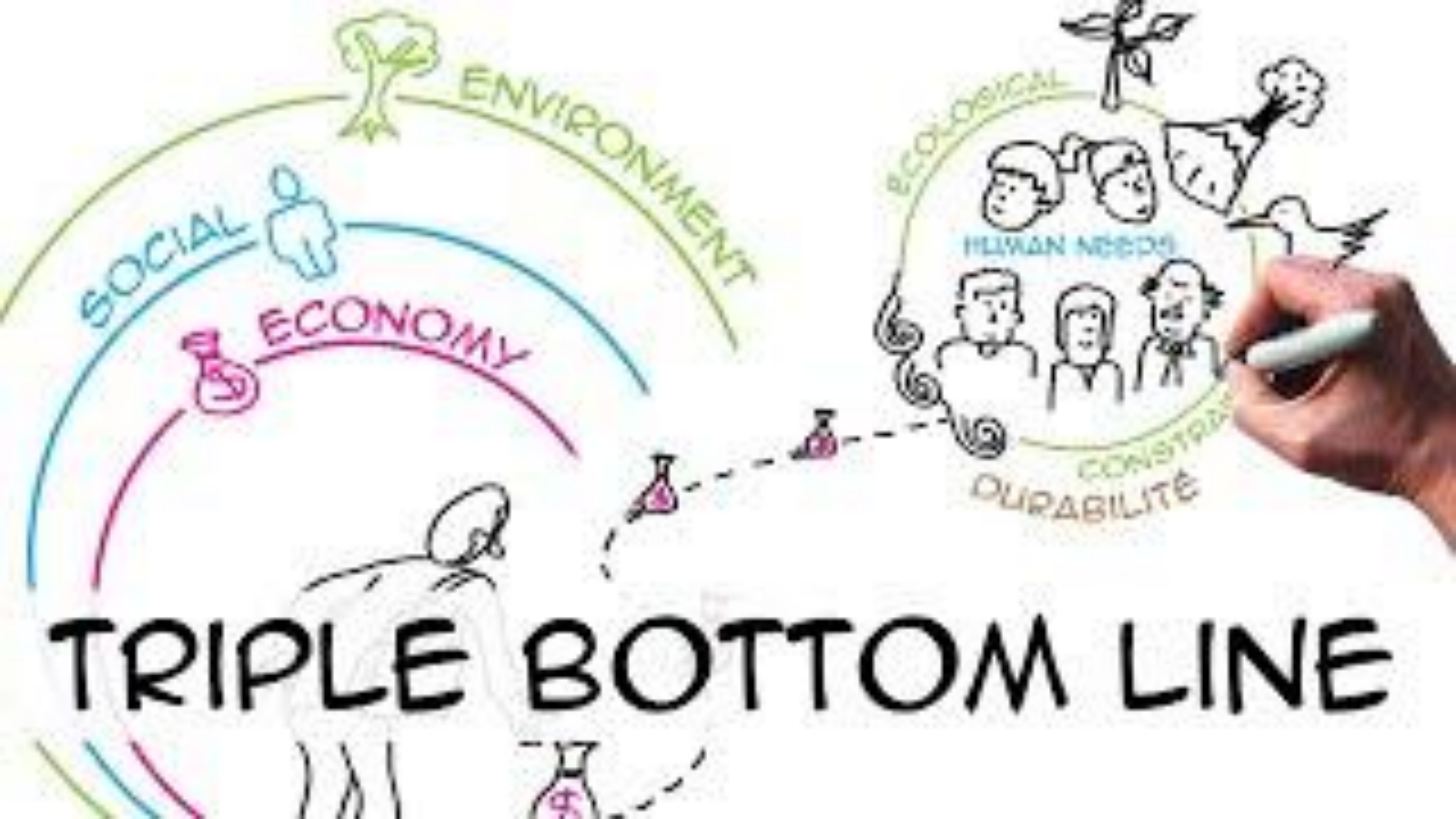
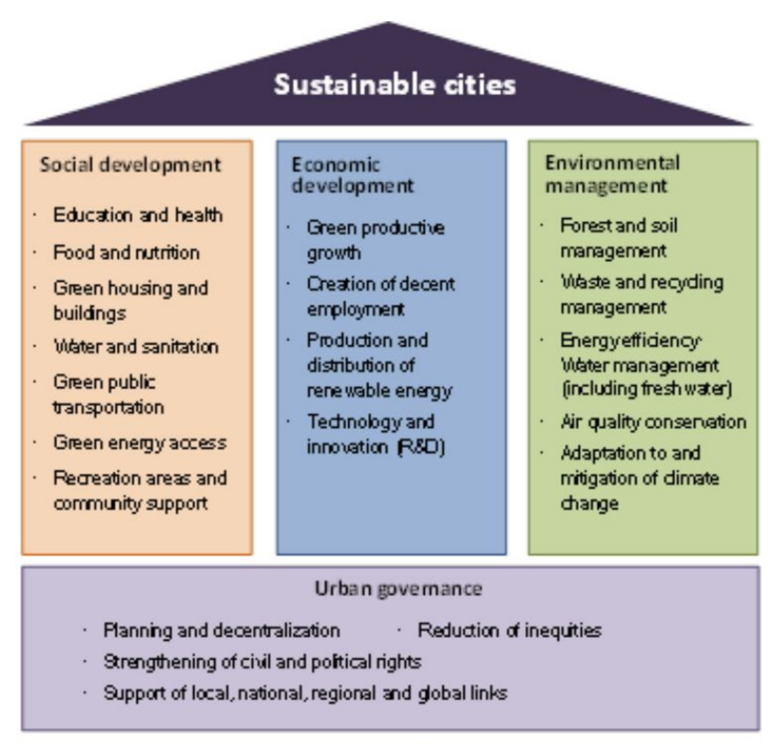
What is a sustainable city?


ENVIRONMENT
SOCIAL
ECONOMY
ECOLOGICAL
HUMAN NEEDS
CONSTRA
DURABILITE
TRIPLE BOTTOM LINE



Sustainable cities

Social development

- Education and health
- Food and nutrition
- Green housing and buildings
- Water and sanitation
- Green public transportation
- Green energy access
- Recreation areas and community support

Economic development

- Green productive growth
- Creation of decent employment
- Production and distribution of renewable energy
- Technology and innovation (R&D)

Environmental management

- Forest and soil management
- Waste and recycling management
- Energy efficiency Water management (including fresh water)
- Air quality conservation
- Adaptation to and mitigation of climate change

Urban governance

- Planning and decentralization
- Reduction of inequities
- Strengthening of civil and political rights
- Support of local, national, regional and global links

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

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?

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.

SDG 11:

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

11
SUSTAINABLE CITIES AND COMMUNITIES

TARGET 11·1
SAFE AND AFFORDABLE HOUSING

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

TARGET 11·2
AFFORDABLE AND SUSTAINABLE TRANSPORT SYSTEMS

TARGET 11·3
INCLUSIVE AND SUSTAINABLE URBANIZATION

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 11·4
PROTECT 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

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 11·6
REDUCE THE ENVIRONMENTAL IMPACT OF CITIES

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

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

TARGET 11·A
STRONG NATIONAL AND REGIONAL DEVELOPMENT PLANNING

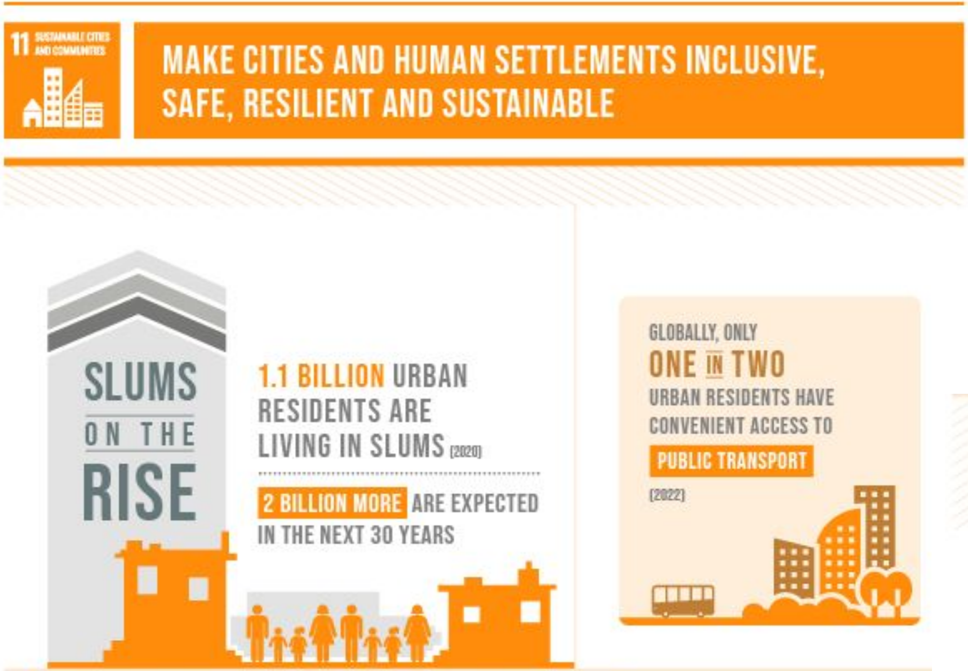
TARGET
11▸B
IMPLEMENT POLICIES FOR INCLUSION, RESOURCE EFFICIENCY AND DISASTER RISK REDUCTION

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

TARGET
11▸C
SUPPORT LEAST DEVELOPED COUNTRIES IN SUSTAINABLE AND RESILIENT BUILDING

WO


11 SUSTAINABLE CITIES AND COMMUNITIES

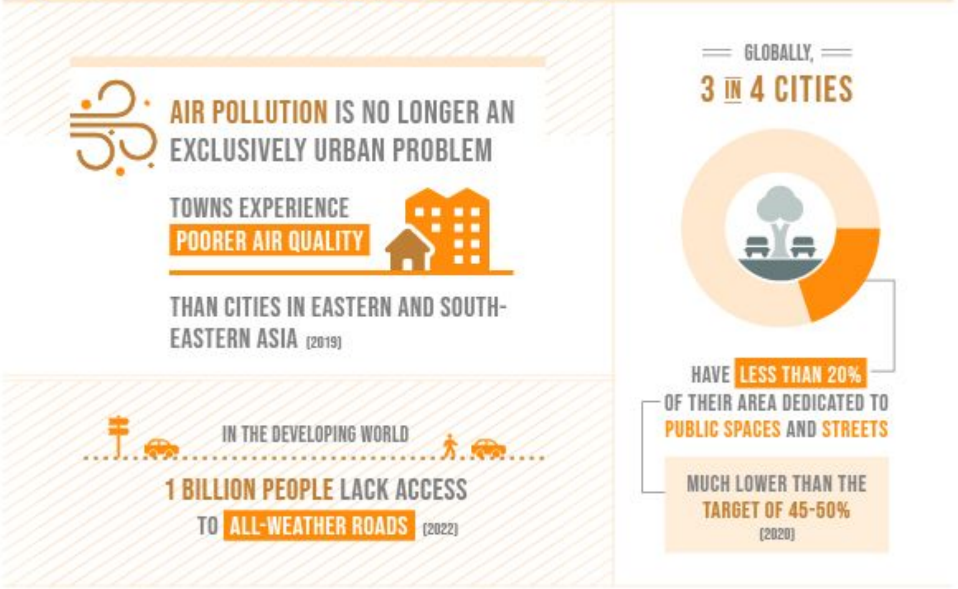
MAKE CITIES AND HUMAN SETTLEMENTS INCLUSIVE, SAFE, RESILIENT AND SUSTAINABLE

SLUMS ON THE RISE

1.1 BILLION URBAN RESIDENTS ARE LIVING IN SLUMS (2020)

2 BILLION MORE ARE EXPECTED IN THE NEXT 30 YEARS

GLOBALLY, ONLY ONE IN TWO URBAN RESIDENTS HAVE CONVENIENT ACCESS TO PUBLIC TRANSPORT (2022)


AIR POLLUTION IS NO LONGER AN EXCLUSIVELY URBAN PROBLEM

TOWNS EXPERIENCE POORER AIR QUALITY THAN CITIES IN EASTERN AND SOUTH-EASTERN ASIA (2019)

IN THE DEVELOPING WORLD

1 BILLION PEOPLE LACK ACCESS TO ALL-WEATHER ROADS (2022)

GLOBALLY, 3 IN 4 CITIES HAVE LESS THAN 20% OF THEIR AREA DEDICATED TO PUBLIC SPACES AND STREETS

MUCH LOWER THAN THE TARGET OF 45-50% (2020)

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

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

ALSO

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

8 DECENT WORK AND ECONOMIC GROWTH
16 PEACE, JUSTICE AND STRONG INSTITUTIONS

PR

BREAK

WOMEN STEM UP

Nairobi

Sustainable and Inclusive Cities

May 2025

LINKÖPING UNIVERSITY

UNIVERSITY OF THESSALY

STIMMULI for social change

NTNU Norwegian University of Science and Technology

DIGITAL LEADERSHIP INSTITUTE WOMEN STEM UP

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

- Roads only cater to motorised transports (cars dominate most of the urban space) (only 20% of roads have footpaths (iRAP))
- Lack of inclusive infrastructure restricts mobility and access to opportunities for people with disabilities.
- Reliance on informal transport (matatus and boda bodas)

Solution

1. Formalize and improve the transportation
2. Improve the pedestrian infrastructure
3. Invest in Non-motorized Transport (NMT)
4. accessible design

WOMEN STEM UP

Technology

Smart Mobility and Integrated Transport System (real time public transit tracking such as Moovit)

Drawbacks:

1. Only for people with smartphones or digital literacy
2. cost of infrastructure is high
3. Matatu driver

AI and Data driven traffic management (since Nairobi is so congested)

Drawbacks:

Require a huge energy and electricity and high cost for infrastructure

Micro-mobility and non-motorized transport (NMT)

Drawbacks:

1. Not suitable for elderly, disabled,
2. can be expensive if the budget is constraint
3. formalizing system- regulation

What is Nairobi doing well?

Green Spaces: Nairobi has major green zones like Karura Forest, Uhuru Park, and Nairobi Arboretum

Issue?

Unequal Access to Green Spaces:

Informal settlements and low-income neighborhoods often lack safe, accessible green areas.

Neglect and Encroachment:

Some public parks face degradation due to poor maintenance or threats from development.

Safety and Inclusivity:

Inadequate lighting, security, and accessibility features make many parks unusable for women, children, and people with disabilities.

Solution:

Public-private partnership such as scale karura model (invite school, NGOs, small business) and also offer tax incentive or CSR recognition to maintain funding, co design the area.

Final solution for transportation:Invest in affordable and reliable public transit.

1. Formalizie public transport (matatus, bodas)
2. Scaleup Bus Rapid Transit (BRT) especially for low-income areas such as Eastlands, Kayole, Kibera
3. Subsidize public transport to be more affordable

Environmental impact:

-Fewer private vehicle= less emissions.

-Improved air quality

-Reduced noise pollution

-Climate resilience

pros:

-Increases safety, reliability, and regulation

-Supports livelihoods in the transport sector

-Reduces traffic congestion and emissions

-Makes the city more accessible for everyone

cons:

-High initial cost

-Require major policy and regulation changes

-Digital divide (especially for app-based ticketing or real time transportation apps)

-Matatu job losses (reduce jobs in informal transportation)

Is it resilience?

✔ **Yes, if designed properly**

- It adapts to shocks (fuel price surges, pandemics).
- Electric buses can adapt to climate goals.
- BRT lanes are flexible and can be re-routed if needed.

❌ **No, if…**

- It depends on a centralized system with weak maintenance.
- Excludes informal economies or marginal areas.
- Fails to plan for floods, heat, or other climate-related impacts.

Who might be left behind?

1. People who lack access to the internet
2. People with disabilities
3. Low income people
4. Rural-urban commuters
5. People
6.

Solution:

-Subsidize fares for vulnerable users
-Train and integrate current operators
-Prioritize safety, accessibility, and coverage in all neighborhoods

Singapore

Sustainable and Inclusive Cities

May 2025

LINKÖPING UNIVERSITY
UNIVERSITY OF THESSALY
STIMMULI for social change
NTNU Norwegian University of Science and Technology
DIGITAL LEADERSHIP INSTITUTE WOMEN STEM UP

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

- x
- y
- z

[chosen city inclusivity issue]

[your brainstormed urban design solution(s)-bold your chosen!]

WOMEN STEM UP

WOMEN STEM UP

STEM Jobs Connected to Sustainable and Inclusive Cities

1. Urban Planning & Infrastructure

- **Urban Planning**
    - Urban Sustainability Manager
    - Community Development Specialist
    - Urban Health Planner
- **Civil Engineering**
    - Building Systems Engineer
    - Infrastructure Project Manager (focused on sustainability)
    - Green Infrastructure Specialist
- **Architecture**
    - Sustainable Building Designer
    - Urban Resilience Designer
    - Smart Cities Architect
- **Sustainable Design & Engineering**
    - Urban Sustainability Manager
    - Green Infrastructure Specialist
    - Environmental Consultant (Urban Planning)
- **Transportation Engineering**
    - Sustainable Transportation Planner
    - Smart Mobility Manager
    - Urban Data Analyst (for transport data)

2. Environmental & Resource Management

- **Environmental Engineering**

  - Water Resources Engineer
  - Waste Management Engineer
  - Environmental Consultant (Urban Planning)

- **Environmental Science**
  - Climate Change Specialist (Urban Focus)
  - Environmental Risk Analyst
  - Urban Sustainability Consultant

- **Renewable Energy Engineering**
  - Energy Systems Engineer (for smart cities)
  - Sustainable Energy Consultant (Urban Development)
  - Renewable Energy Consultant (Urban Infrastructure)

- **Agricultural Engineering**
  - Urban Agriculture Specialist
  - Vertical Farming Consultant
  - Sustainable Food Systems Planner (for urban areas)

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3. Technology & Smart City Systems

- **Computer Science/Information Technology**
  - Smart Cities Engineer
  - Urban Data Analyst
  - ICT Consultant for Smart Cities

- **Electrical Engineering**
  - Smart Grid Engineer
  - Energy Efficiency Engineer
  - Building Systems Engineer (focused on smart systems)

STEM Jobs Connected to Sustainable and Inclusive Cities

- **Geographic Information Systems (GIS)**
    - Urban Data Analyst
    - GIS Consultant for Smart Cities
    - Urban Planning Data Analyst
- **Data Science and Analytics**
    - Urban Data Analyst (focused on city metrics)
    - Smart City Data Manager
    - Public Health Data Analyst (for urban settings)
    - Urban Planning Data Analyst
- **Network Engineering**
    - Smart City Network Engineer
    - IoT Network Specialist
    - Cybersecurity Engineer (for Smart Cities)
    - 5G Network Architect
    - Telecommunications Engineer

4. Energy & Environmental Sustainability

- **Renewable Energy Engineering**
    - Energy Systems Engineer (for smart cities)
    - Solar Energy Consultant (Urban Areas)
    - Urban Sustainability Consultant (focused on energy solutions)
- **Electrical Engineering**
    - Smart Grid Engineer
    - Sustainable Energy Infrastructure Designer
    - Energy Efficiency Consultant (for cities)

5. Social & Inclusive Urban Development

STEM Jobs Connected to Sustainable and Inclusive Cities

- **Social Sciences (Urban Studies/Public Policy)**
    - Urban Health Planner
    - Social Equity Policy Analyst
    - Community Engagement Specialist
- **Human-Centered Design**
    - Urban Innovation Specialist
    - Inclusive Urban Design Consultant
    - Smart Cities User Experience Designer
- **Public Health**
    - Urban Health Planner
    - Public Health Policy Analyst
    - Environmental Health Specialist (focused on urban spaces)

6. Urban Resilience & Disaster Management

- **Disaster Resilience and Recovery**
    - Disaster Resilience Planner (for cities)
    - Risk Management Specialist
    - Urban Disaster Recovery Specialist
- **Risk Management**
    - Urban Risk Management Consultant
    - Environmental Risk Analyst
    - Climate Change Resilience Specialist

7. Health & Well-being in Urban Settings

STEM Jobs Connected to Sustainable and Inclusive Cities

- **Public Health**
    - Urban Health Planner
    - Public Health Policy Analyst
    - Environmental Health Specialist (focused on urban settings)

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8. Food Systems & Agriculture

- **Agricultural Engineering**
    - Urban Agriculture Specialist
    - Sustainable Food Systems Planner (for urban areas)
    - Vertical Farming Consultant

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9. Legal & Ethical Aspects of Urban Development

- **Urban Law/Policy**
    - Urban Policy Analyst
    - Zoning and Land Use Consultant
    - Sustainability Compliance Officer
- **Sustainability Studies**
    - Sustainability Consultant (focused on urban development)
    - Green Building Code Specialist
    - Urban Sustainability Policy Advocate

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10. Innovation & Entrepreneurship

- **Urban Innovation & Entrepreneurship**

    - Smart City Entrepreneur
    - Sustainability Business Owner (focused on urban solutions)
    - Urban Innovation Specialist

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11. Biology & Environmental Science

- **Environmental Biology**
    - Urban Ecologist
    - Environmental Consultant (focusing on urban ecology)
    - Urban Green Space Planner
    - Conservation Biologist (focused on urban wildlife)
- **Marine Biology** (for coastal cities)
    - Coastal Management Specialist
    - Marine Pollution Control Analyst
    - Environmental Restoration Specialist
- **Biology (General)**
    - Urban Agriculture Specialist
    - Sustainability Biologist (focused on biological systems for green infrastructure)

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12. Chemistry & Environmental Chemistry

- **Environmental Chemistry**
    - Air Quality Analyst
    - Water Quality Specialist
    - Chemical Process Engineer (focused on sustainable practices)
    - Pollution Control Engineer
- **Chemistry**

    - Green Chemistry Specialist (developing eco-friendly materials)
    - Sustainable Materials Developer (working on recyclable or biodegradable materials for cities)

- **Industrial Chemistry**
    - Sustainable Manufacturing Engineer
    - Waste Management Chemist

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13. Mathematics & Data Science

- **Applied Mathematics**
    - Urban Data Analyst
    - Smart Cities Analyst
    - Climate Change Modeler
- **Statistics**
    - Environmental Data Analyst
    - Urban Planner (using statistical models for sustainable growth)
    - Public Health Analyst (for urban settings)
- **Computational Science/Computer Science**
    - Data Scientist (optimizing urban systems like energy use and traffic)
    - Smart City Algorithm Developer
- **Operations Research**
    - Urban Systems Engineer
    - Sustainability Operations Manager

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14. Environmental Engineering & Sustainability

STEM Jobs Connected to Sustainable and Inclusive Cities

- **Environmental Engineering**
    - Water Resources Engineer
    - Wastewater Treatment Engineer
    - Renewable Energy Engineer
- **Chemical Engineering (Sustainability Focus)**
    - Sustainable Process Engineer
    - Green Energy Solutions Developer

15. Climate Science & Meteorology

- **Atmospheric Sciences**
    - Climate Change Specialist (urban focus)
    - Urban Heat Island Effect Analyst
    - Air Quality Forecasting Specialist

16. Geospatial Science & Remote Sensing

- **Remote Sensing/Geospatial Science**
    - Geospatial Data Analyst
    - Urban Planning Consultant
    - Environmental Monitoring Specialist

17. Bioengineering & Biotechnology

- **Bioengineering**
    - Green Biotechnology Specialist

STEM Jobs Connected to Sustainable and Inclusive Cities

  - Urban Bioengineering Specialist

- **Biotechnology**
  - Urban Agriculture Biotechnologist
  - Environmental Biotechnologist