U-Care

TECHNISCHE UNIVERSITÄT BERLIN

Building Health Lab

University of Cyprus

CHALMERS UNIVERSITY OF TECHNOLOGY

UNIVERSITÀ DEGLI STUDI FIRENZE

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Co-funded by the European Union

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Project number: 2023-1-ES01-KA220-HED-000155347

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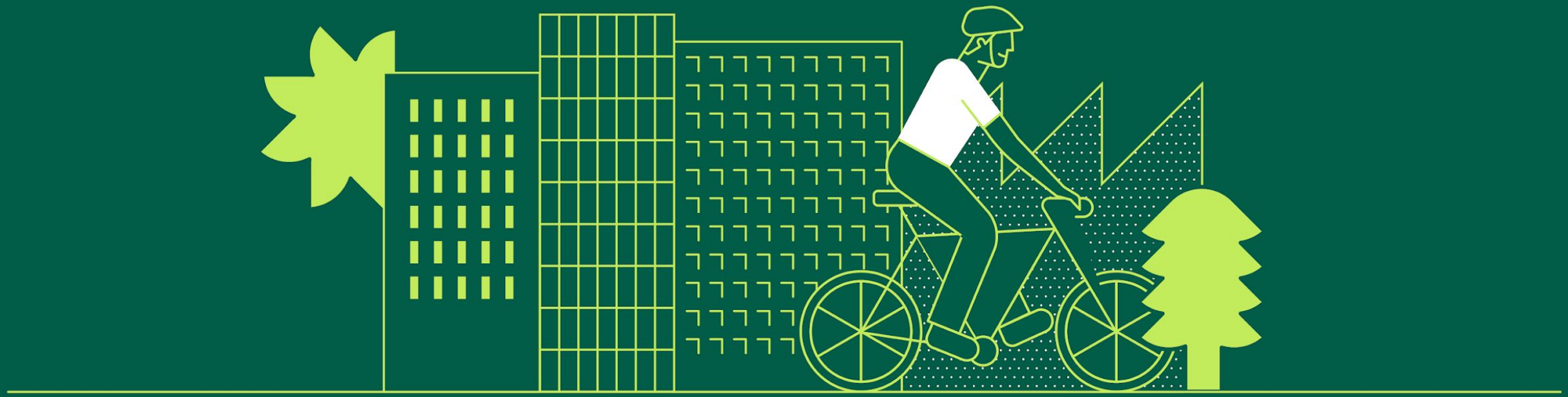

UrbanCare Session 3: Urban Heat Diagnostics and Value Creation

by **Alvaro Valera Sosa** | November 2025

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UrbanCare Methodology

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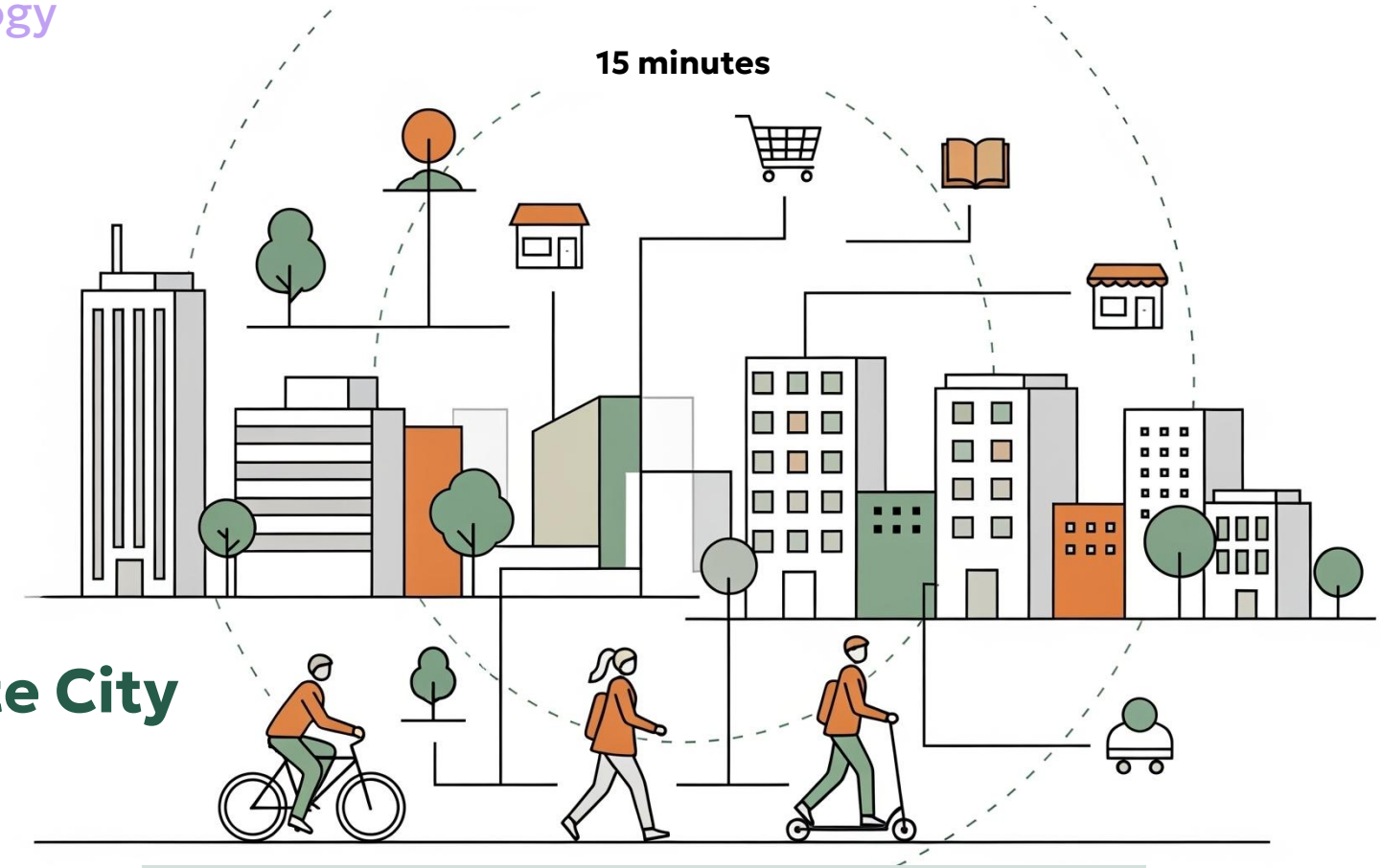
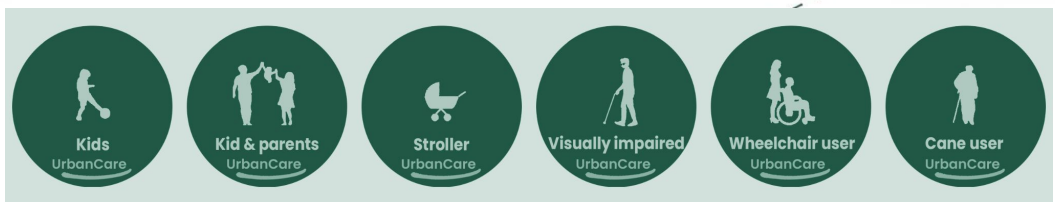


15-minute City



How far do slower paced groups travel in 15-minute Cities?

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Walkability Summary

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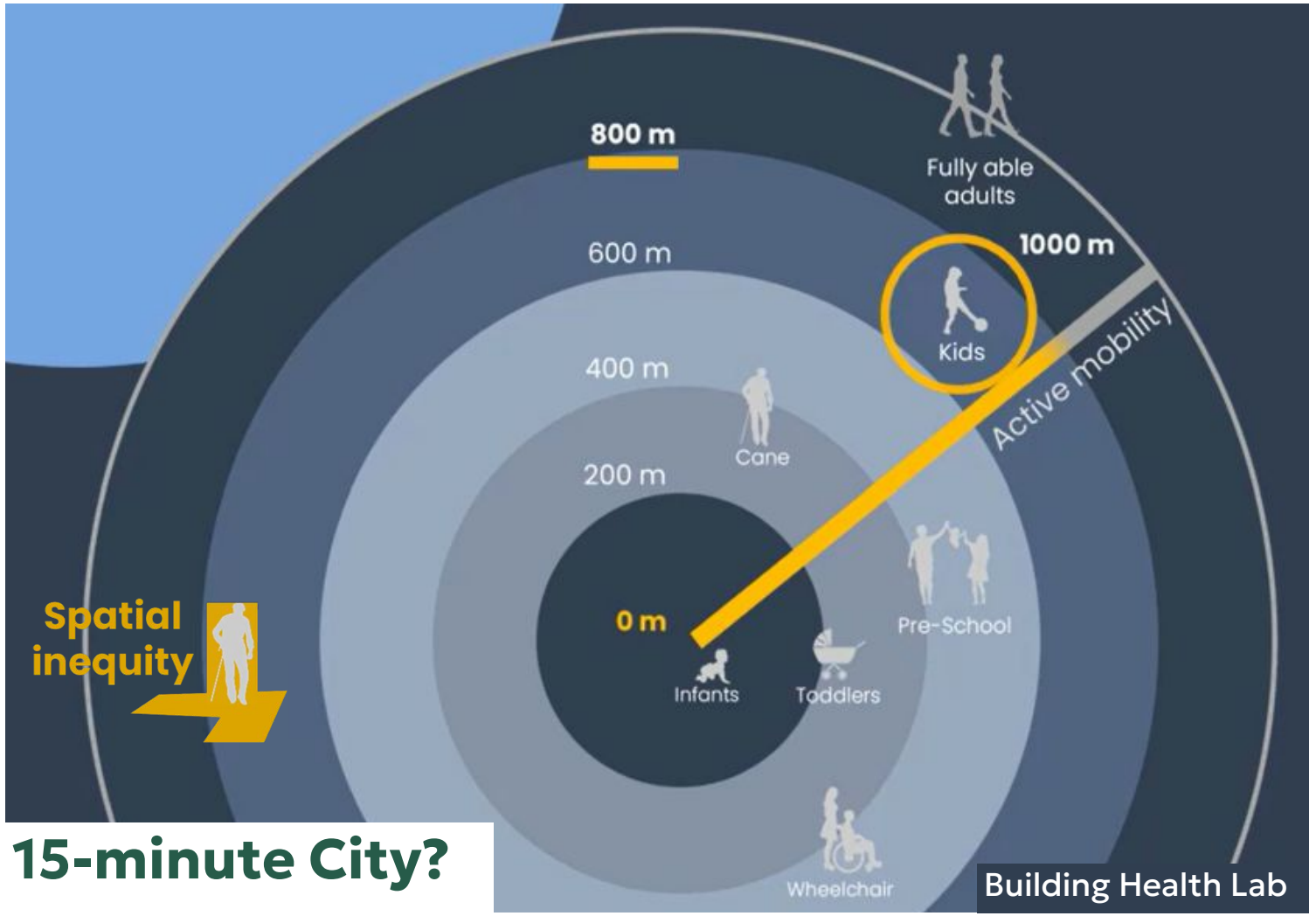

Effort

Walkability

Runoff

Heat

Exposure

Biotope

15-minute City?

What happens to slower paced groups in 15-minute Cities?

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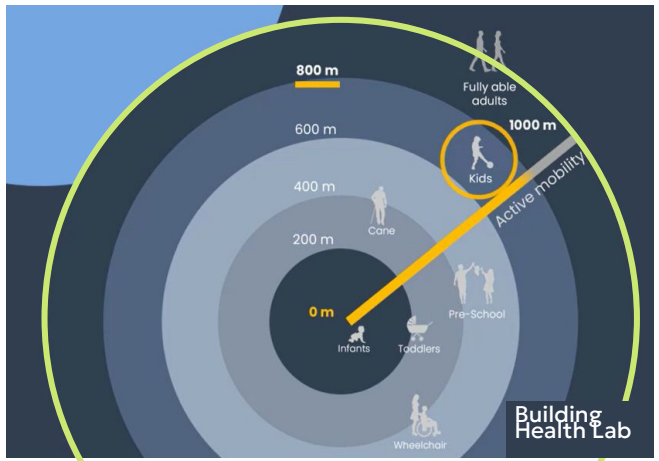

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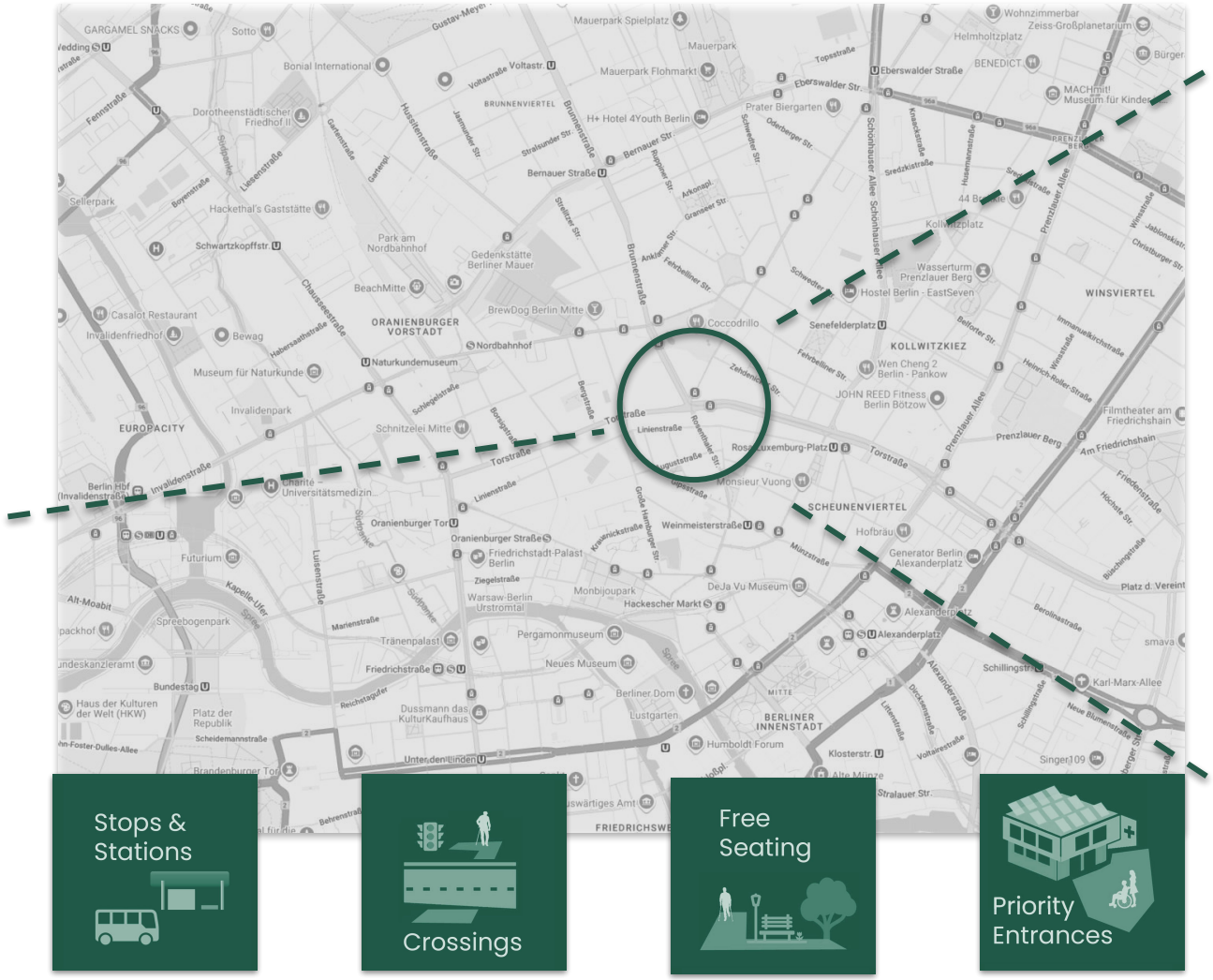

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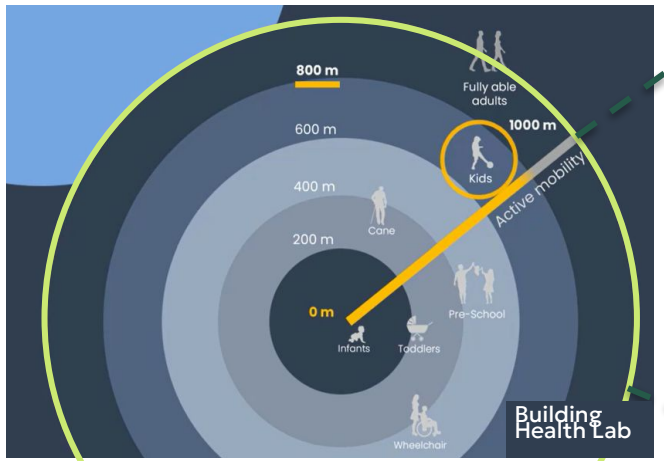

Effort

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Small problems here ...

... and across the city, translates to enormous waste!

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Walkability

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Walkability: **Definition**

Walkability Mechanisms

Walkability

Path Continuity?

Block-to-block Connectivity?

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Walkability: Urban Health **Impacts**

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Walkability

1. Health:

lower physical activity; exclusion and reduced social interaction; higher chronic disease risk; accidents leading to physical trauma

2. Climate:

increased car dependence; higher emissions; reduced active mobility uptake; weakened potential for climate-adaptive streets; more heat from traffic volumes

3. Economy:

increased healthcare expenditure from chronic disease and traffic-related injuries; productivity losses from limited active mobility and travel delays; higher transport costs; reduced footfall for local businesses; higher maintenance and operational costs from car-reliant infrastructure

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Walkability: Planning & Design **Approach**

Walkability

1. Convenience:
directness and efficiency of pedestrian environments without detours or interruptions

2. Safeness:
protection of pedestrians from traffic conflicts and environmental hazards

3. Comfort:
physical quality of the walking experience

4. Attractiveness:
elements that make routes inviting and engaging

Convenience

Safeness

Comfort

Attractiveness

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Surface Runoff

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Surface Runoff: Definition

Surface Runoff

1. Hortonian runoff (infiltration-excess)
Rainfall exceeds the soil's infiltration rate.

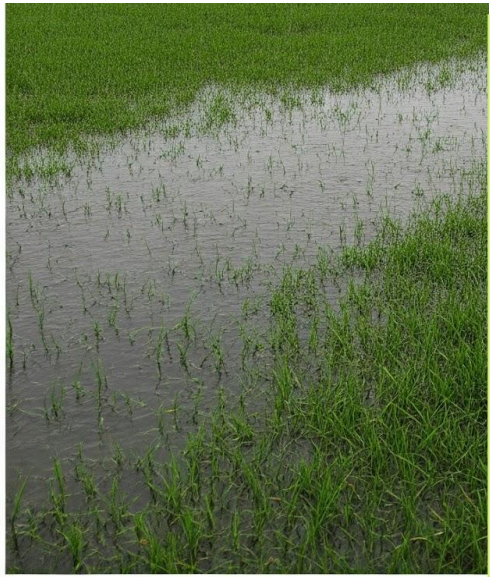
2. Saturation runoff (soil fully saturated)
Rainfall exceeds the soil's storage capacity.

3. Impervious-surface direct runoff
Where infiltration can't occur, such as roofs, asphalt and concrete.

4. Return flow (subsurface → surface)
When infiltrated water travels laterally underground and resurfaces downslope.

Hortonian Runoff

Saturation Runoff



Impervious-surface Runoff

Return Runoff

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Surface Runoff: Urban Health **Impacts**

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Surface Runoff

1. Health:

flood exposure; mobility disruption for vulnerable groups; injury risks at crossings; contamination from combined sewer overflow; mold and dampness in buildings; water-borne and vector-borne diseases from contaminated floodwater

2. Climate:

increased stormwater peaks; reduced infiltration and groundwater recharge; altered local humidity; erosion risk; degraded soil moisture balance

3. Economy:

healthcare and productivity losses from water-related illnesses and injury events; damage to infrastructure; maintenance and drainage costs; avoidable water treatment costs; business interruption; emergency response costs; insurance and repair costs

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Surface Runoff: Planning & Design **Approach**

Surface Runoff

1. Infiltration:
water enters soil or permeable surfaces to reduce surface runoff

2. Retention:
water is held temporarily and released slowly to lessen peak flows

3. Detention:
water is stored long-term on-site to delay or prevent downstream flooding

Infiltration Retention Detention

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Urban Heat

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Urban Heat: **Definition**

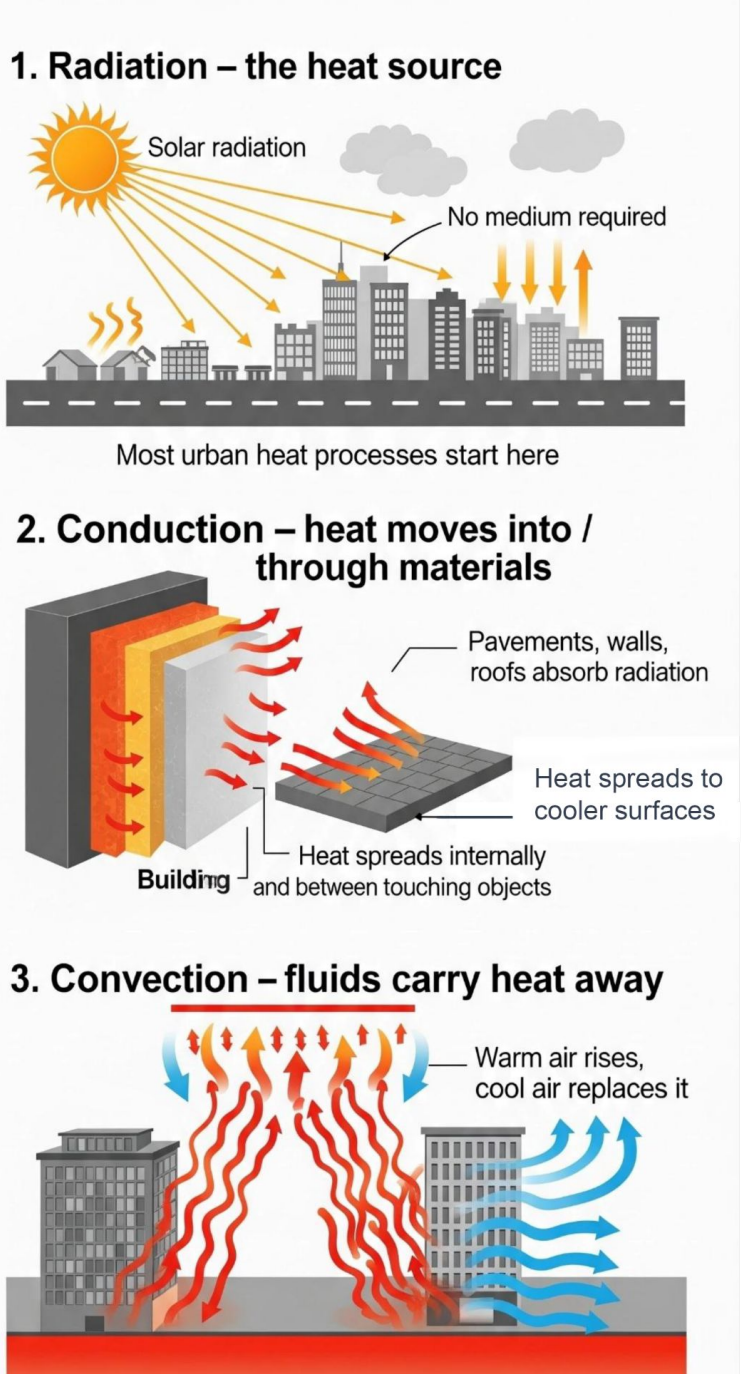
Heat Transfer Mechanisms

Urban Heat

1. Radiation:
solar energy is absorbed by urban surfaces and increases surface temperatures

2. Conduction:
heat moves and is stored within materials and spreads to adjacent surfaces

3. Convection:
heated surfaces warm surrounding fluids and transfer heat into the air



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Urban Heat: Urban Health **Impacts**

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Urban Heat

1. Health:

heat stress; cardiovascular strain; dehydration; sleep disturbance; respiratory burden from ozone and particulate concentrations; heightened vulnerability for elderly, children and people with chronic conditions

2. Climate:

higher surface temperatures; intensified urban heat islands; reduced nighttime cooling; altered humidity; stress on vegetation and urban ecosystems

3. Economy:

healthcare and productivity losses from heat-related illnesses and reduced functional capacity; increased cooling energy costs; productivity loss in workplaces and schools; infrastructure degradation from thermal expansion; operational delays in mobility and service disruptions

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Urban Heat: Planning & Design **Approach**

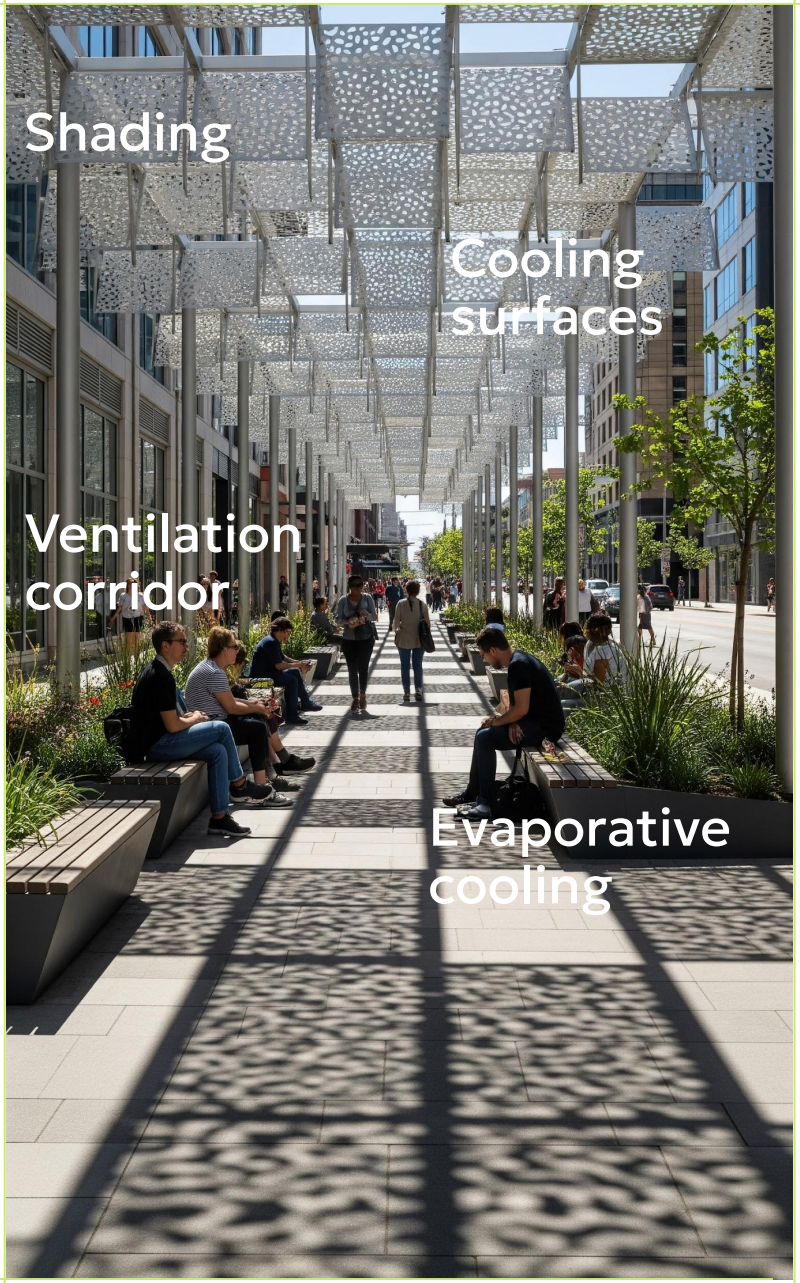
Urban Heat

1. Shading:
engineered shading against direct solar radiation

2. Cooling surfaces:
use of materials and coatings to reflect solar radiation, absorb less heat, and lower surface temperatures while reducing heat buildup

3. Ventilation corridors:
urban layouts that improve air movement to disperse stored

4. Evaporative cooling:
use of vegetation and water systems that cool air



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Urban Heat **Assessment**

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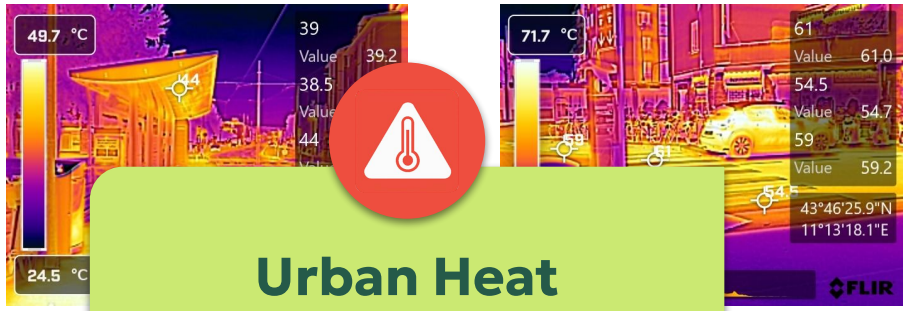

Urban Heat

Effort

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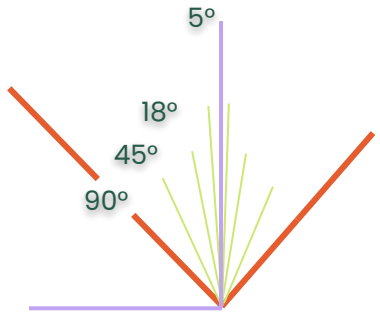

Stops & Stations

Crossings

Free Seating

Priority Entrances

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Urban Heat **Assessment**

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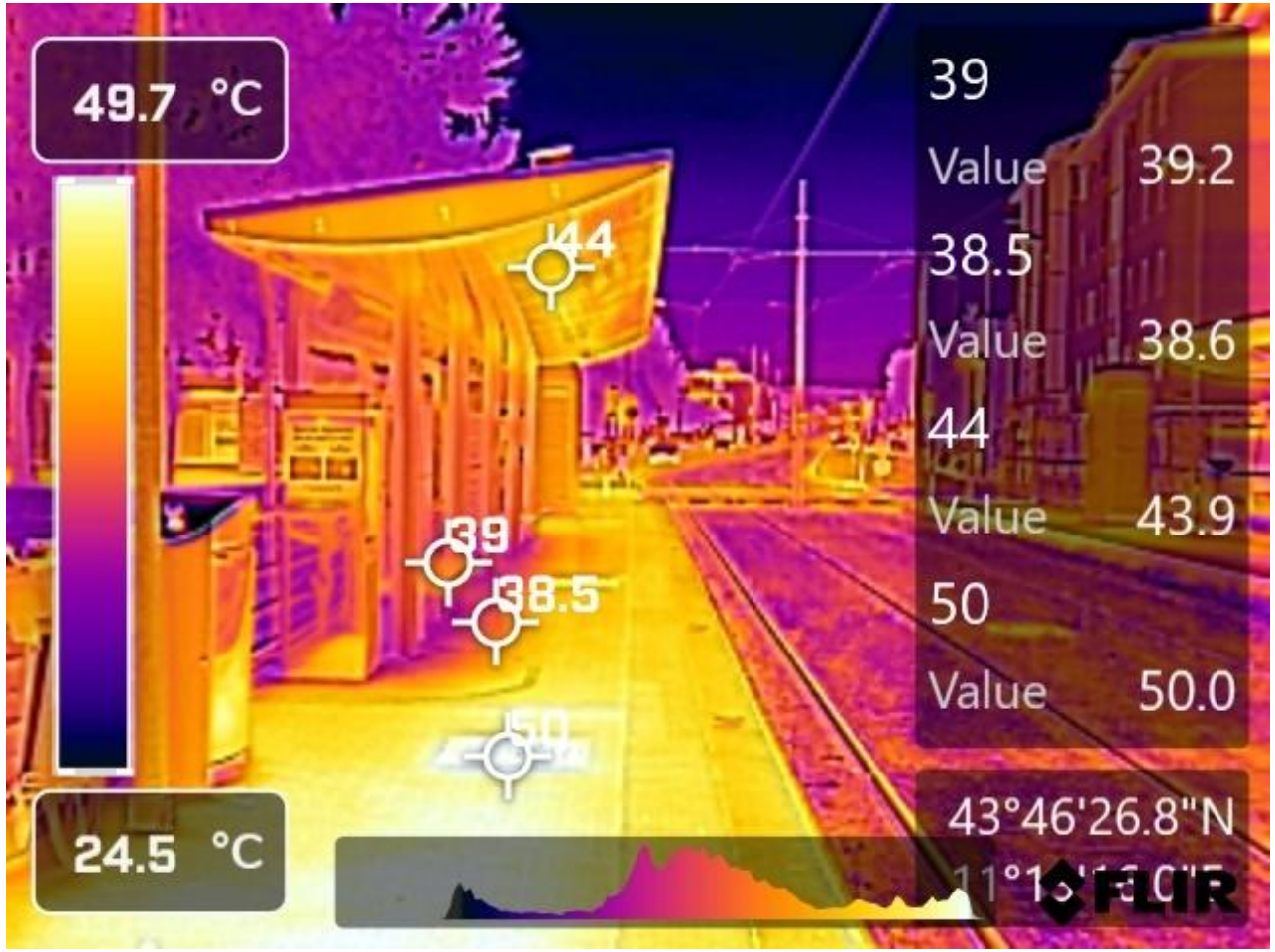
Urban Heat



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Urban Heat **Assessment**

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Urban Heat

Urban Heat Index (UHIx) =

Street level heat survey

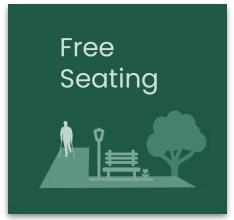
A simplified observational method to assess heat-amplifying conditions in urban scenes.

UHIx =
Combined Heat Amplification Score

A higher combined score means the site has:

- more radiant heat gain (R)
- more stored heat in materials (C)
- less capacity to dissipate heat through air movement (V)

Suitable for street-scale assessments using photographs as proxies for thermal readings.



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Urban Heat **Assessment**

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Urban Heat

Urban Heat Index (UHIx) =

Street level heat survey

A simplified observational method to assess heat-amplifying conditions in urban scenes.

UHIx = R + C + V

R = Radiation Score (0.0–0.3)

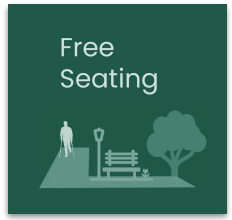
Assesses exposure to solar radiation based on surface colour, reflectivity, shading, and openness.

C = Conduction Score (0.0–0.3)

Evaluates the amount of heat-storing materials (asphalt, stone, brick, metal) and size of exposed hard surfaces.

V = Convection/ Ventilation Score (0.0–0.3)

Assesses airflow restriction from street canyons, blocked breezeways, and wind shadows



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Urban Heat **Evidence Task**

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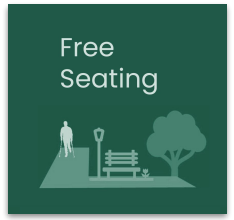
Urban Heat

Task A:

Select an Urban Scene type and document surfaces and spatial conditions that amplify heat through radiation, conduction, and convection.

- Identify surfaces that intensify Radiation (dark asphalt, glass façades, exposed paving, unshaded areas)
- Identify materials that store heat through Conduction (stone, concrete, metal, brick, compacted surfaces)
- Identify configurations that affect Convection (narrow street canyons, blocked corridors, enclosed courtyards, wind shadows (low wind zones))
- Assign a score to each component using the 0.0–0.3 scale (low / moderate / high heat potential)
- Write a short interpretation (5–7 lines) explaining:
  - which mechanism dominates the scene
  - where heat accumulates most strongly
  - how spatial form contributes to heat stress
  - and one intervention that would reduce the UHIx score



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Urban Heat **Evidence Task**

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Urban Heat

Task B:

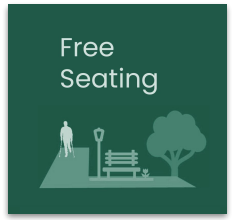
Find quick, reliable evidence showing how urban heat affects economic outcomes.

Identify 2–3 reliable sources that show how higher urban temperatures relate to:

- increased healthcare costs from heat-related illness
- productivity loss in workplaces and schools
- higher energy use for cooling
- infrastructure damage from thermal stress
- mobility and service disruptions during extreme heat

Deliverable:

- Write 3–5 sentences summarizing:
  - the main findings from your sources, and
  - how they relate to runoff conditions in your chosen Urban Scene
- Search keywords: “urban heat economic impact”; “heat stress productivity loss”; “extreme heat infrastructure costs”



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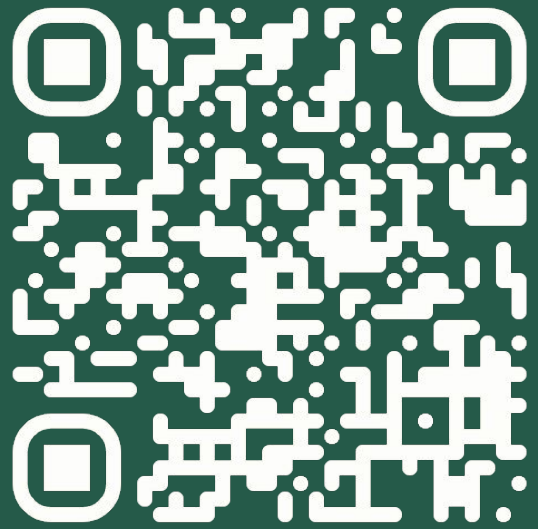

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