URBAN COOLING
TOOLBOX

FOREWORD

More than half of the world's population live in cities today and the urban population is expected to grow to about 68% by 2050. This fact alone puts a strain on our urban environment. Additionally, climate change is already affecting cities around the world and is provoking new planning and design pathways to adapt to this changing urban environment. Especially, the projected rise in temperatures and frequency of extreme heat events are impacting urban planning scenarios.

The number of cities exposed to extreme temperatures will nearly triple over the next decades. By 2050 more than 970 cities will experience average summertime temperature highs of 35˚C (95°F).

This increase in extreme heat puts pressure on essential services in cities, such as energy, water, and transport, and also has critical implications on overall health and well-being of citizens.

Extreme heat in cities is often exacerbated by the Urban Heat Island (UHI) effect. The UHI effect describes the phenomenon where an urban area is significantly warmer than the surrounding lands, due to an increased fraction of paved surfaces in cities, lack of vegetation and generated heat from urban activity.

Mitigating the UHI effect and creating comfortable and safe public spaces year-round is one of the primary components when designing sustainable and resilient communities.

In 2019 as part of the Copenhagen Urban Lab hosted by Ramboll, a diverse team of experts from across the world was tasked with developing an urban comfort strategy for a case area in Copenhagen. As part of the Lab the participants also developed this Toolbox.

Subsequently, C40 Cities and Ramboll collectively expanded and finalized the Toolbox to make it available to the public. The different cards of the Toolbox are designed to inspire municipalities, designers, planners, administrators, and users to think about the multitude of options available for adapting to extreme heat in cities and improving urban comfort.

We would like to extend our gratitude to all who has contributed to the development of the Toolbox. We hope that the Toolbox will assist cities in creating more liveable and resilient communities.

PROPOSED APPROACH
IMPROVING URBAN COMFORT

We recommend following Ramboll's 4-step approach to integrated resiliency planning developed through experiences from Copenhagen and other cities across the world.

GIS data, detailed hazard modeling and spatial overlays constitute the baseline in providing a solid basis for informed decision-making and identifying potential synergies and cumulative effects.

The figure illustrates the iterative process of moving from initial determination of baseline conditions and potential risks (1), to the co-development of an integrated urban comfort and resiliency plan (2), documenting the adaptation effect (3), and comparing investments, avoided risks and co-benefits (4) in a cost-benefit analysis (CBA).

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- Grey infrastructure
- Communication and outreach
- Policy
- Urban development

CO-BENEFIT SYMBOLS

- Stormwater management
- Human health
- Biodiversity
- Walkability
- Water conservation
- City with an edge
- Cloudburst flooding
- Thermal comfort
- Energy savings
- Multi-generation usage

GREEN INFRASTRUCTURE

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PERMEABLE PAVEMENT

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BIOSWALE

RAINGARDEN

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PARKS/OPEN GREENERY

TREES

PUBLIC PRIVATE

Urban trees provide ecosystem services to help combat the UHI. Trees provide shade by covering streets and walkways with large canopies that protect from sunlight and heat. Trees also provide cooling because they absorb water and then release the moisture through the leaves into the air (evapotranspiration). It is the most efficient heat mitigation approach, when clustering is employed, which is important for a cooling effect.

KEEP IN MIND

- Prioritize tree planting in heat vulnerable areas
- Species selection adapted to climate conditions and based on cooling impact
- Tree management (digital tools) and maintenance (in-house or out-sourced) crucial
- May affect air-pollutants as it reduces air flow

Examples:
Melbourne's 'Urban Forest Strategy'
Guadalajara's 'Tree Manual' (Spanish)
New York City's Street Tree Planting Standards

GREEN FACADES

PUBLIC PRIVATE

Green facades - or 'living walls' and 'vertical gardens' - are vegetative layers of small plants, grass and/or moss attached to external building facades. The climbing plants can be either directly attached to the building surface or can be supported on an independent structure. The plants grow from garden beds at the ground or in containers installed at different levels of the building.

KEEP IN MIND

- Need careful species selection and maintenance
- Saltwater (e.g. from water run-off) may harm some species in winter
- Green facades give buildings an attractive look which may lead to increased property prices
- Water requirements in drier climates

Examples:
Sydney's Green Walls policy & design guide
Bogota's Practical to Green roofs and vertical gardens (Spanish)
London's Living Roofs and Walls – from policy to practice

PERMEABLE PAVEMENT (VEGETATED)

PUBLIC PRIVATE

In lieu of traditional pavers, a roadbed composed of a mixture of stones, pavers, and vegetation allows water infiltration of nearly a quarter centimeter per minute. The water stored in the pavement/the soil beneath can evaporate and cool the pavement during summer. Permeable vegetated pavements can be used for footpaths, cycle paths, playgrounds, parking lots, tree pits etc.

KEEP IN MIND

- Porous pavement requires maintenance, typically annually
- Vegetation must be salt and water resilient
- Sensible to drought

Examples:
Barcelona's Green Corridor permeable pavements
Washington DC's Permeable pavement programme for home owners

GREEN CORRIDORS

PUBLIC PRIVATE

Consist of larger collection of trees and / or other vegetation along streets or water features, which provides a green solution to the urban heat issues. Connecting green spaces as corridors can create a wind induced cooling effect by reducing the local ambient temperature, thus enhancing the overall cooling impact.

KEEP IN MIND

- Consider the trees/vegetation selection that are drought resistant/local/low water demand
- Green corridors enhance the biodiversity in a city, as the connected green spaces allow for a better exchange of wildlife

Examples:
Medellin's Green Corridors
Lisbon Green corridors

RAISED GARDEN BEDS

PUBLIC PRIVATE

A raised garden bed is a large planter on top of or elevated off a surface, typically constructed of wood or metal. Raised beds can be moved and incorporate additional design features such as seating and bicycle infrastructure. In addition to providing shade and evaporative cooling, raised beds trap rainwater, and soils can trap heat from sunlight during cooler months.

KEEP IN MIND

- Require maintenance
- Opportunity for community engagement projects
- Trapped water can be re-channelled to be re-used

Examples:
San Francisco's Public Parklets
Paris' Vegetation programme (including mobile planters)

BIOSWALE

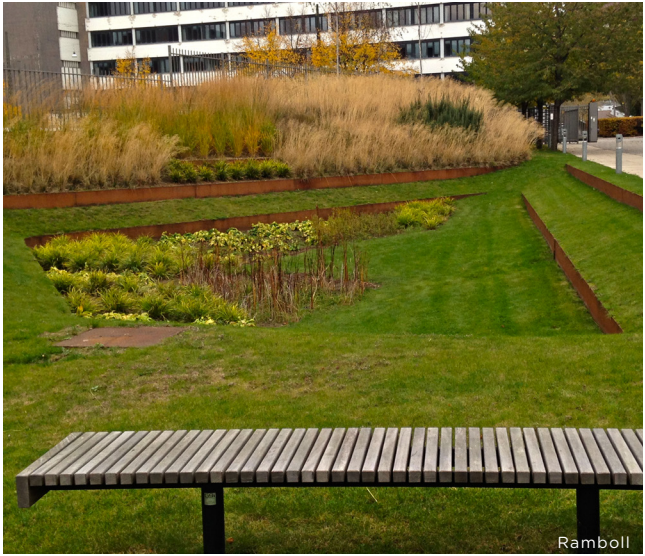
PUBLIC PRIVATE

Bioswales are dredged, linear channels that collect and manage runoff, typically while removing some pollutants. Bioswales are usually vegetated, but also can be mulched or designed to have a reduced need for irrigation.

KEEP IN MIND

- Requires maintenance
- Vegetation must be able to withstand salty conditions in cities where salt is used on winter streets
- Requires thawing to function in winter

Examples:
Rotterdam's Adaptation Strategy includes bioswales
Copenhagen's Cloudburst Management Plan



RAIN GARDEN

PUBLIC **PRIVATE**

Rain gardens are a vegetated form of bioretention. Typically in a lower lying area, rain gardens are used to collect and manage runoff. By capturing runoff water, rain gardens also contribute to cooling the air.

KEEP IN MIND

- Requires maintenance
- Vegetation must be able to withstand salty conditions
- Requires thawing to function in winter

Examples:
Montreal's Guide on capturing rainwater
New York City's Rain gardens Programme

GREEN ROOFS- INTENSIVE

PUBLIC PRIVATE

Intensive green roofs are 'roof gardens' that have a deeper layer of soil, which allows the roof to accommodate large plants, paving, water features, lawns, shrubs or even trees. Intensive green roofs are often designed as recreational spaces, and they can be used as public green spaces.

KEEP IN MIND

- Site & building assessment to understand feasibility and costs
- Consider weight load and drainage needs
- Need frequent maintenance and irrigation
- Suitable for urban agriculture
- Can increase property values

Examples:
Durban Green Roofs Design Guidelines
London's Living Roofs organization
Paris Guide to vegetated roofs

GREEN ROOFS- EXTENSIVE

PUBLIC PRIVATE

Extensive green roofs are light-weight roof solutions with a shallower layer of substrate, that require less maintenance than intensive green roofs. They are mostly made of mosses, sedums, succulents, herbs or grasses and are often designed to increase biodiversity in cities.

KEEP IN MIND

- Site & building assessment to understand feasibility and costs
- Consider weight load
- Have lower watering requirements
- Selection of plants adapted to climatic conditions

Examples:
Melbourne's Growing Green Guide
Madrid's Various green roofs projects
Mexico City Green roofs on public and private buildings

PARKS/OPEN GREENERY

PUBLIC **PRIVATE**

Large parks can have a great cooling effect in cities, as they allow wind to flow and the vegetation creates shade and evapotranspiration. Parks can also host numerous leisure activities, such as sports facilities, which help increase public health.

KEEP IN MIND

- Maintenance can be done by the Municipality or by subtracted partners
- Keeping parks secure especially at night-time

Examples:
Montreal's Network of large parks
Durban's Metro Open Space System
London National Park City

BLUE INFRASTRUCTURE

DRINKING FOUNTAINS

WATER BODIES/FOUNTAINS

PUBLIC SWIMMING POOL/WATER SPRAY PARKS

WATER COOLING

RAIN BARREL/EXPOSED RAINWATER RETENTION

DRINKING FOUNTAINS

PUBLIC **PRIVATE**

A public drinking fountain is a source of potable water for passers-by. It can be used to drink directly from or fill a water bottle. Placing drinking fountains across the city helps to keep citizens hydrated and make them less vulnerable during heat waves.

KEEP IN MIND

- Must be winterized
- Cleaning maintenance is necessary to ensure use and hygiene

Examples:
Berlin's Drinking fountains
Hong Kong's 'Water for Free' app
Melbourne's Online map of drinking fountains

WATER BODIES/ FOUNTAINS

PUBLIC PRIVATE

Open water bodies or fountains decrease the air temperature by evaporative cooling and absorption of heat. With the aid of natural wind flow, water can also help to cool the surrounding areas. Repairing historic fountains and installing new ones can therefore have a thermal relief on hot days. Also revitalising urban rivers or smaller streams can have a cooling effect as well as benefits for recreation for nearby residents.

KEEP IN MIND

- Water quality (waterborne diseases)
- Water consumption (especially in drought periods)
- Integration in a broader water management plan
- Fountains require regular monitoring and maintenance

Examples:
Madrid's Water features
Sydney's Water cooling study
São Paulo's Ipiranga Stream Revitalisation

PUBLIC SWIMMING POOL/ WATER SPRAY PARKS

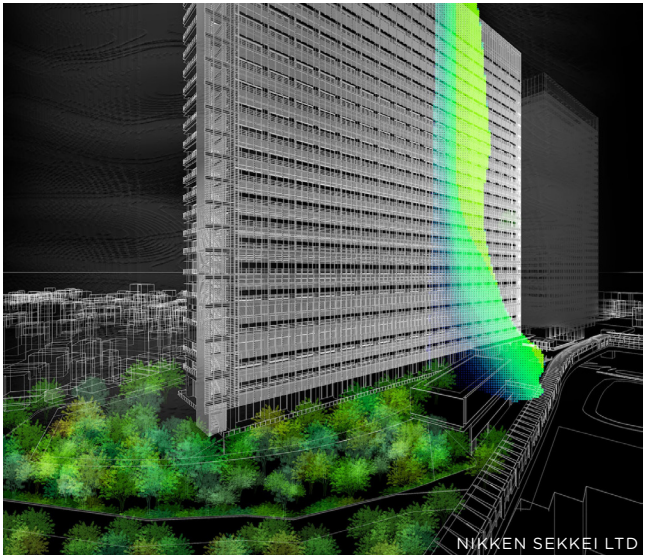
PUBLIC **PRIVATE**

A network of public swimming pools provides heat relief to people on hot summer days. Water spray parks are safe water play areas within public parks that use significantly less water than swimming pools. Spray parks are particularly beneficial for children to refresh during heat waves.

KEEP IN MIND

- Water quality & water consumption (especially in drought periods)
- Maintenance of pool facilities
- Small entry fee can create revenue
- Consider tidal pools (where applicable)

Examples:
Berlin's Public swimming pools
Los Angeles' Citywide aquatics and swimming pools
Cape Town's Water spray parks



WATER-COOLING

PUBLIC **PRIVATE**

Using captured rainwater and gravity, a variety of designs can be installed to direct water to cool building facades through wetting and evaporation.

KEEP IN MIND

- The systems' costs may be too high in many contexts
- Not always applicable to protected buildings
- Must be turned off in cooler months to prevent freezing
- Systems require cleaning and maintenance

Examples:
Tokyo Commercial building using water façade cooling

RAIN BARREL/EXPOSED RAINWATER RETENTION

PUBLIC PRIVATE

A rain barrel is a semi-permanent storage container used to capture rainwater to reuse for irrigation. Barrels, cisterns, or permanent basins can vary in size and retention capacity. A connected system can collect rainwater from around a site or an area. Rain barrels can be distributed to public and private buildings to collect rainwater and use to water plants, as part of a public program. Programs like this lead to significant reduction in potable water use for garden irrigation.

KEEP IN MIND

- Standing water in basins can attract mosquitos
- Rainwater can pick up runoff pollutants
- Must be disconnected in winter
- Requires proper use and maintenance

Examples:
New York City's Rain barrel giveaway programme

GREY INFRASTRUCTURE

COOL ROOFS
FACADE SHADING
GROUND SHADING STRUCTURE
SOLAR WINDOW FILM
SHUTTERS / BLACKOUT CURTAINS
CEILING FANS
TRICKLE VENTS
LOW-ENERGY VENTILATION SYSTEMS
PASSIVE COOLING IN BUILDINGS
COOL PAVEMENTS
EVAPORATIVE FACADE COOLING

COOL ROOFS

PUBLIC PRIVATE

A cool roof is one designed to reflect sunlight and lower heat absorption. Cool roofs are typically made of a highly reflective type of paint, a sheet covering, or highly reflective tiles or shingles. On buildings without air conditioning, a white roof can reduce inside temperatures by 2 to 3 degrees Celsius (4 to 5 degrees Fahrenheit), making buildings more comfortable and possibly saving lives in extreme heat waves.

KEEP IN MIND

- Can keep the building cooler during summer
- Not always applicable to protected buildings

Examples:
Melbourne's Cool Roofs Guide
Seoul's Cool roofs
New York City Cool Roofs Initiative

FAÇADE SHADING (NON-VEGETATED)

PUBLIC PRIVATE

A structure applied to the outside or roof of a building that provides temporary or permanent shade from sunlight, thus improving thermal comfort. Movable solar shades used for sun-facing windows can reduce building energy demand and also improve indoor thermal comfort by as much as 20% during summer.

KEEP IN MIND

- Movable structures are better so sunlight is accessible in colder months, reducing heating demand

Examples:
Melbourne's Council House 2

GROUND SHADING STRUCTURE

PUBLIC PRIVATE

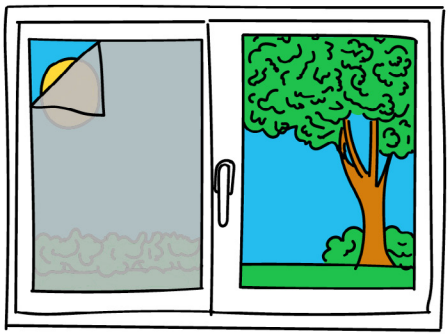
Any structure that provides temporary or permanent shade from sunlight, thus improving thermal comfort. For example, shading structures can be used on squares, alongside walking and cycling routes, span narrow roads, or to cover street cafe seating. Temporary shades can prevent up to 98% of solar radiation directing onto people and urban surfaces.

KEEP IN MIND

- Movable structures are better so sunlight is accessible in colder months.

Examples:
Tel Aviv's Urban shade initiative
Tokyo Fractal shading
Madrid's Shading structures

HOME COOLING TIP



SOLAR WINDOW FILM

PUBLIC **PRIVATE**

Solar window film is a protective, tinted coating that can be applied to existing windows and cut to size. Most films incorporate metallic coatings or dyes that transmit less solar energy through the window. This effect lowers heat gain and cooling needs, while some highly insulated films can also lower heating demand.

KEEP IN MIND

- Can darken spaces during winter
- Does not effectively raise thermal mass

SHUTTERS / BLACKOUT CURTAINS

PUBLIC PRIVATE

Shutters are exterior, deployable window closures that can prevent entry of unwanted sunlight, cold air, and wind into indoor spaces.

Blackout curtains are interior solutions that can be added to existing windows in order to prevent unwanted sunlight from entering a space and that keep room temperature at a comfortable level.

KEEP IN MIND

- Shutters not applicable for building facades with protections
- Shutters cannot close over window air conditioning units
- Does not effectively address energy-efficiency in hotter months
- Some designs can absorb heat

(CEILING) FANS

PUBLIC PRIVATE

A ground, table or ceiling fan is a mechanical fan, typically electric, that uses mounted rotating blades for air circulation. With dual settings, a ceiling fan can both cool a space and improve the circulation of heated air.

KEEP IN MIND

- Not all buildings have appropriate wiring
- Requires electricity
- Only appropriate where the ceiling is approximately at least 2.5M high.

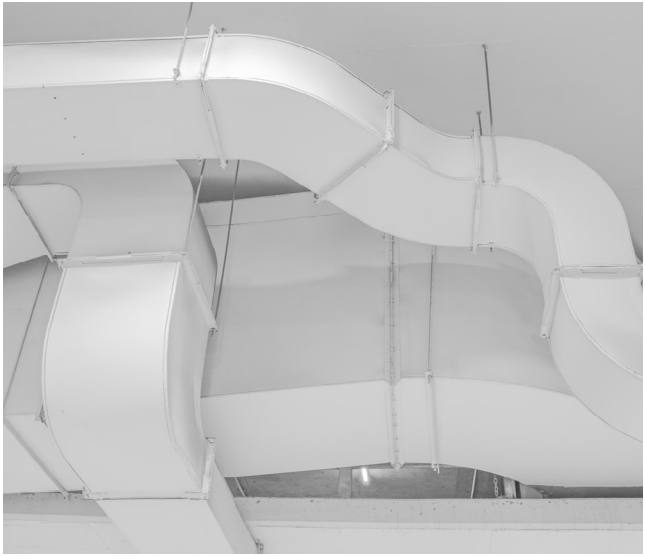
TRICKLE VENTS

PUBLIC PRIVATE

A trickle vent is a tiny opening in a building envelope to allow small amounts of natural ventilation into a space when other elements, such as windows and doors, are closed. These vents can help indoor spaces keep cool while reducing condensation.

KEEP IN MIND

- In air-conditioned spaces, these can lead to increased energy



LOW-ENERGY VENTILATION SYSTEMS

PUBLIC PRIVATE

By employing a more energy efficient ventilation system/air-conditioning (AC) system, the indoor air temperature can be lowered. There are alternative ACs that use water and less electricity.

KEEP IN MIND

- As AC systems consume electricity, they contribute the rise of greenhouse gas emissions
- The city-wide increased use of AC can lead to a strain on power grids
- AC produce excess heat outside the building that can contribute to the urban heat island effect.

PASSIVE COOLING IN BUILDINGS

PUBLIC **PRIVATE**

Passive cooling refers to natural convection or heat dissipation with the aim of lowering energy consumption. It utilizes non-mechanical means, such as ambiental cooling sinks. The cooling techniques are for instance wind circulation, natural shading, thermal mass of materials, roof ponds, integrated in the architectural design.

KEEP IN MIND

- Passive building cooling features can be most easily integrated with new buildings designs but can also be retrofitted into already existing buildings

COOL PAVEMENTS (REFLECTIVE)

PUBLIC PRIVATE

Conventional paving materials absorb heat from sunlight and can reach peak summertime temperatures of 50-65°C, heating the air above them. There are many kinds of paving options that are lighter in colour and have greater reflectivity (albedo), less heat capacity and more permeability. Cool paving options can be applied on roads, walking & biking ways, parking lots etc. and help mitigate the Urban Heat Island Effect.

KEEP IN MIND

- Reflectivity changes over time
- Product availability
- Enhance visibility at night-time
- Glare & human discomfort

Examples:
Tokyo's Thermal barrier coated pavement
Los Angeles' Cool Streets LA

EVAPORATIVE FACADE COOLING

PUBLIC PRIVATE

Evaporative systems refer to water-mist based systems that provide a cooling effect on building facades. The system uses evaporation of water, which is sprayed as a mist from a system of small mounted pipes at the building facade. Thus the accumulation of energy is reduced and a cooling impact is provided on the local ambient environment.

KEEP IN MIND

- Dissolved solids of impurities or biological contaminants can raise in concentration in the equipment, which leads to a lower water quality that is being recirculated

COMMUNICATION AND OUTREACH

COOLING CENTRES

OUTREACH CAMPAIGN

COMMUNICATION CAMPAIGN

Mass live

COOLING CENTRES

PUBLIC PRIVATE

Cooling centres - also called “climate refuges”, “cool spots”, or “cool islands” – are public or private spaces within a city, which are set up by local authorities to temporarily protect citizens from the health effects of a heat wave. Those spaces can be public libraries, museums, schools, parks, sports club houses, shopping malls, swimming pools that are open access and communicated to citizens as spaces to get heat relief.

KEEP IN MIND

- Extend opening hours for summer months
- Provide medical aid in some of the cooling centres
- Apps can help localise cooling places and the coolest routes between them

Examples:
Toronto
Washington DC
Philadelphia

OUTREACH CAMPAIGN

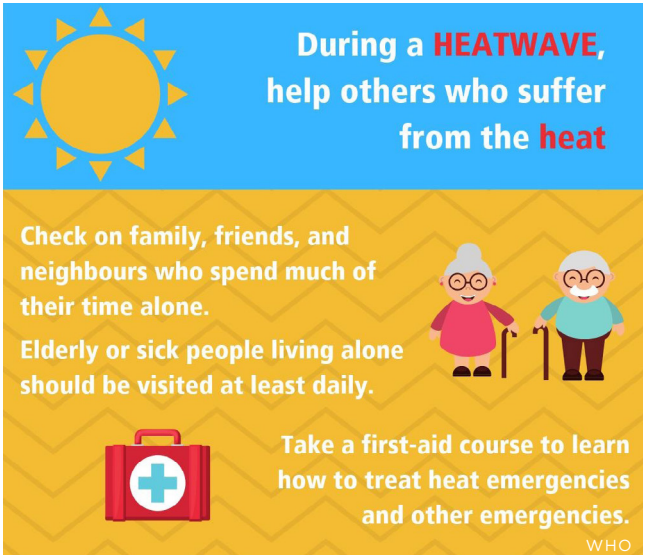
PUBLIC PRIVATE

To increase community-based resilience, the City can organise heat-awareness workshops in schools or elderly homes. The City can also work with different neighbourhoods, for example, to foster a buddy systems between social service and community organizations, volunteers, and vulnerable citizens, to be deployed during heat emergencies to conduct telephone and, if necessary, door-to-door checks on vulnerable individuals.

KEEP IN MIND

- Understand your audience and local community structures
- Use existing channels and local messengers: Build strong relationships with local community groups and leaders that can help spread the message.
- Developing solutions with communities

Examples:
Buenos Aires Heatwave campaign for elderly
New York City "Be A Buddy"
Philadelphia's Community heat relief plan



Examples:
Athens, Paris & Rotterdam "Extrema App" as emergency notification system for extreme temperatures
Toronto "Beat the Heat" campaign

COMMUNICATION CAMPAIGN

PUBLIC PRIVATE

In case of a heatwave, the City can develop various communication tools to advice citizens on how to stay cool and limit the heat health impacts.

Diversify communication channels, with a focus on reaching the most vulnerable: Not all modes of communication (e.g., social media) are reaching the most vulnerable (e.g., the elderly). So choose outreach channels appropriately.

KEEP IN MIND

- Sending out newsletters/tweets/sms
- Making phone calls for elderly people, visiting elderly homes
- Laying out flyers in high visible/ visited places like pharmacies, bakeries etc.
- Putting up posters on bus/metro stops, building lobbies

POLICY

TRAFFIC REDUCTION

PROPERTY TAX REBATE PROGRAM

COOLING TAX REBATE PROGRAM

INCENTIVES PROGRAM

CLIMATE DESIGN GUIDELINES

COOL/GREEN ROOF REGULATIONS

HEAT EMERGENCY RESPONSE PLAN

TRAFFIC REDUCTION

PUBLIC PRIVATE

There is a close relationship between traffic and UHI, as the intensity of UHI is often caused by vehicular flows, with radiation and transfer occurring between the air and the paving surface. The impact of traffic on UHI is influenced by time-dependent vehicular flows. Heat formation is directly proportional to spatial-temporal patterns of moving vehicles, which leads to the formation of heat peaks on a daily basis

KEEP IN MIND

- Increasing walking & cycling in a city, as well as the network of electric public transport reduces traffic, carbon emissions as well as the Urban Heat Island Effect
- The exhaust emissions impact the level of pollution

Examples:
London Low Emission Zone
C40 Knowledge Hub "How to design and implement a low emission zone"

PROPERTY TAX REBATE PROGRAM

PUBLIC PRIVATE

A tax rebate is a refund on taxes when tax liability is less than taxes paid. To incentivize green and blue infrastructure, for example, a 1% property tax break could be offered per centimeter of on-site stormwater retention and an additional 1% for each centimeter of stormwater reuse for irrigation. Tax rebates would cease over a twenty to thirty-year period.

KEEP IN MIND

- Requires government oversight
- Only works for properties with high investment capital

Examples:
Chicago's Stormwater Management Ordinance Manual
New York City's Guidelines for the Design and Construction of Stormwater Management Systems

COOLING TAX REBATE PROGRAM

PUBLIC PRIVATE

A tax rebate is a refund on taxes when tax liability is less than taxes paid. To incentivize sustainable home cooling interventions, an income tax rebate could be applied for declared improvements. The improvements, provided via proof of receipts, could come from a pre-determined list of eligible items such as installing ceiling fans or solar film on windows.

KEEP IN MIND

- Requires government oversight
- May also require developing partnerships with key stakeholders in the private sector

INCENTIVES PROGRAM

PUBLIC **PRIVATE**

Incentive programmes are to promote the installation of green/white roofs or facades on existing (residential or commercial) buildings and new buildings, or planting of trees and increasing greenery within courtyards.

An incentive programme provides grant funding for buildings owners to install new roofing materials or building retrofits that provide environmental benefits and build resilience.

KEEP IN MIND

- Requires government oversight
- May also require developing partnerships with key stakeholders in the private sector

Examples:
Barcelona Green roofs competition
Toronto Eco-roof incentive programme
Singapore 'LUSH' policy

CLIMATE DESIGN GUIDELINES

PUBLIC PRIVATE

Climate Design Guidelines are aimed at municipal or private developments. They recommend design interventions in response to climate change impacts beyond the minimum requirements in local codes and standards. Design teams should consider project benefits and additional costs when incorporating resilient design standards and finalizing project design. Co-benefits will be directly dependent on the focus of the guidelines.

KEEP IN MIND

- Guidelines are not binding
- Development centres can be created in which the guidelines are binding e.g. green building zones

Examples:
NYC Climate Resilient Design Guidelines:
Melbourne Water sensitive design guidelines:

COOL/GREEN ROOF REGULATIONS

PUBLIC **PRIVATE**

Policies can encourage the construction of cool or green roofs, by offering practical and attainable solutions and establishing a sound base for specification, installation and maintenance. Cities can introduce a bylaw to require and govern the construction of green/cool roofs on new developments. A Green Roof Bylaw sets out a graduated green roof requirement for new developments that are greater than a certain number of m^2 in gross floor area.

KEEP IN MIND

- Needs to be regulated/monitored by city government

Examples:
Los Angeles Cool Roofs Rebates programme
Singapore Green Buildings regulations
Toronto Green roofs bylaw

HEAT EMERGENCY RESPONSE PLAN

PUBLIC PRIVATE

Cities can establish an heatwave emergency response plan that is being activated in an event of a heat wave.

An early warning system and preparedness plan for extreme heat events is crucial in coordinating the emergency response and to reduce the health impacts of extreme heat on vulnerable populations.

KEEP IN MIND

- Co-developing the emergency response plan with community groups and leaders
- Effective communication of heatwave protocols

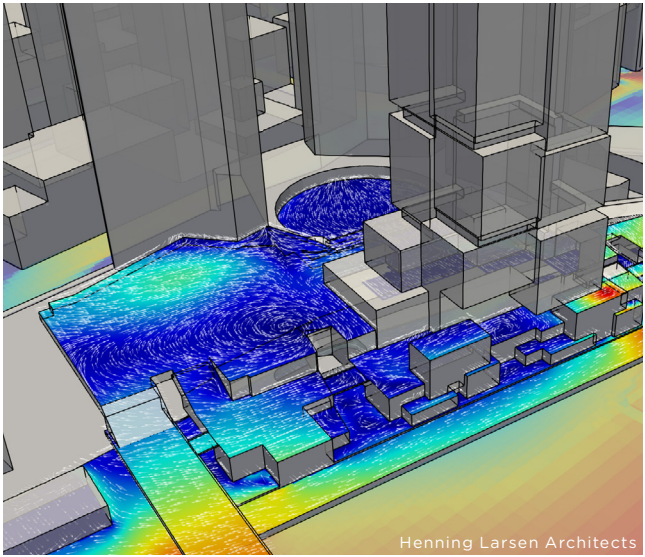
Examples:
Paris Heatwave response plan
Washington DC Heatwave emergency plan
Ahmedabad Heat-action-plan

URBAN DEVELOPMENT

URBAN GEOMETRY

BUILDING MATERIALS

HEAT RESILIENT CITIES TOOL



URBAN GEOMETRY

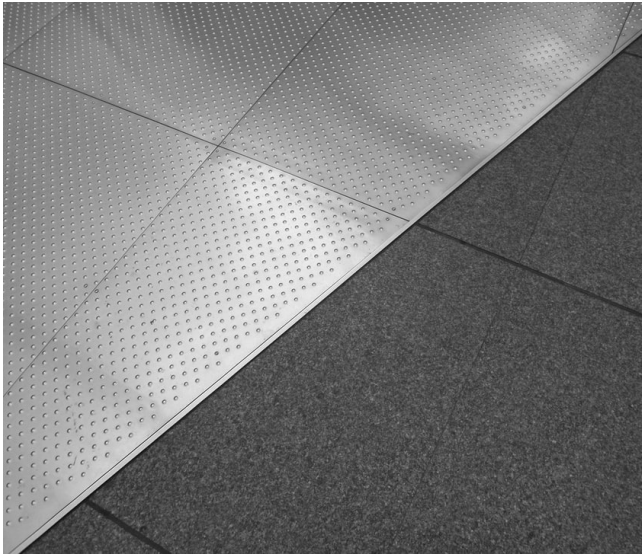
PUBLIC PRIVATE

Consideration of integrating blue green infrastructure (BGI) during the early phases of the massing studies will help ensure effective mitigation of UHI. Additionally, consideration of the Sky View Factor (SVF), as well as orientation of individual buildings or building blocks in relation to air flow and shading between buildings can have a huge impact on the urban comfort.

KEEP IN MIND

- Urban geometry can be relevant both at the building and building block level
- Urban geometry can improve urban comfort in the public space by focusing on the integration between the built environment and the open spaces
- Urban geometry can refer to the height and the design of a building or the spacing between buildings

Examples:
Guangzhou China Singapore Guangzhou Knowledge Town
Riyadh Creating a sustainable city in the Arabian desert



Examples:
Melbourne Council Office Building

BUILDING MATERIALS

PUBLIC PRIVATE

Building material choice can contribute immensely to the cooling effect inside buildings. Materials are able to provide passive cooling, by decreasing demand and also provide thermal comfort indoors. Properties that improve heat insulation are thermal conductivity, thermal lag, low reflectivity, high volumetric heat capacity. The effect scales when materials possess multiple properties from those listed above.

KEEP IN MIND

- Materials with high density are good heat insulators
- Effective thermal insulation can be used in addition/alternatively
- Windows can add to the cooling effect, when glass with low solar heat gain is chosen
- Choosing also less carbon intensive materials

[Download here!]

HEAT RESILIENT CITIES TOOL

PUBLIC PRIVATE

Estimating the impact on citizen health is not easily done. A wide selection of urban heat adaptation options exist, but evidence of their capacity to address extreme heat temperatures is often scattered. The Heat Resilient Cities Tool is developed to assist decision-makers in making an action-to-health impact assessment.

KEEP IN MIND

- The tool provides the user with calculated impacts on citizen health and related socioeconomic cost reductions, from implementing an adaptation action to urban heat in a selected city, given a set of action- and city-specific parameters.
- The aim of the tool is to provide clear quantifications of beneficial impacts from taking action to reduce urban heat.
- The tool is mainly designed for city planners, who need quantifiable assessments of urban adaptation options and impacts for planning and prioritizing city investments.

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RAMBØLL